

e-Networks in an Increasingly Volatile World



Canada 2006

**Edited by
Andrew Gaudes**

e-Networks in an Increasingly Volatile World

**Proceedings of
The 11th International Workshop on Telework
Fredericton, New Brunswick, Canada
August 28 – 31, 2006**

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Printed in Canada by
University of New Brunswick
ITS Imaging Services
10 Mackay Drive
Marshall d'Avray Hall, Room 106
P.O. Box 4400
Fredericton, NB, Canada
E3B 5A3
Tel: 506-453-4843
Fax: 506-453-5015
E-Mail: helpdesk@unb.ca
August, 2006

ISBN 1-55131-107-0

All chapters in this Proceedings have been subjected to a blind review by two anonymous reviewers.

Preface

The International Telework Workshop Series is the key activity of the International Telework Academy. Since its inception in 1996, the Workshop has developed into the paramount international gathering dedicated to multi-disciplinary research on telework and distributed methods of work. Its major goal is to promote constructive and sustained dialogue between researchers and practitioners, as well as to bring the latest research trends to the public at large.

After ten successful conferences around the world, the 11th International Workshop on Telework was for the first time held in North America: the continent with the greatest percentage of households online. The International Telework Association, and the University of New Brunswick's Faculty of Business Administration, jointly hosted the Workshop on August 28-31, 2006 in Fredericton, New Brunswick: Canada's first city to support a free urban wireless network.

The theme of the 2006 Workshop was "e-Networks in an Increasingly Volatile World." The changing role of employment and government, the increasing rate of technological innovation and a growing concern for continuity through periods of large-scale interruptions resulting from natural, technological, and human-induced events are some of the factors behind a growing sense of uncertainty and social turbulence. A major challenge today is how individuals, organizations and regions can leverage human capital to collaborate through unprecedented and complex work/life-scenarios. The Canada 2006 Workshop focused on work strategies that involve e-networks contributing to greater preparedness, but also offered standing e-work streams present at every Workshop.

My sincere thanks to all that participated in making the Canada 2006 Workshop a success, in particular, the major sponsorship provided by the Faculty of Business Administration and the BMO International Business and Entrepreneurship Centre at the University of New Brunswick. These Proceedings illustrate the valuable contributions made during the Canada 2006 Workshop to the ever-expanding and diverse field of e-work research. I trust that the impact made by the academic and practitioner activity at the 2006 Workshop will serve as an effective bridge to the 12th International Telework Workshop.

Dr. Andrew Gaudes
General Chair
e-Networks in an Increasingly Volatile World
The 11th International Workshop on Telework
Fredericton, New Brunswick, Canada

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e-Collaboration, Technological Innovations, and Support

Rulebase Integration for eCollaboration

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Abstract: This chapter provides a classification of rulebase integration for eCollaboration. A variety of conflicts between rulebases are identified and guidelines for conflict resolutions are suggested. Based on the classification, a framework for rulebase integration is proposed containing two different integration approaches, namely interoperation and interchange. The problem of semantics-preserving rulebase transformation is discussed, and a solution is given. Function serialization and representation during transformation are also discussed and represented in terms of Functional RuleML.

Keywords: Rulebase integration, homomorphism, lossy transformation, conflict resolution.

Introduction

This chapter describes foundational work in semantic information integration central to the cluster of Semantic Web projects at UNB and NRC Fredericton, which are being applied in eBusiness [2], eLearning [4] and eCollaboration [12] scenarios. We show how to define the objects and vocabularies of eCollaboration (e.g., merchandise, services) by rules (including taxonomies). Usually those rules differ, syntactically, semantically, and pragmatically, between (groups of) participants of Web-based collaborations. Therefore rulebase integration techniques are needed, as classified in the current chapter.

The Semantic Web community has its focus on semantic information sharing and reuse. Underlying many Semantic Web applications are rule-based systems. However, the techniques for integration of distributed rule-based systems are still limited. In April 2005,

the first workshop of Rule Interoperability [21] held by W3C, therefore, was a kick-off event for the development of interoperability between heterogeneous rule-based systems. Recalling the work on databases integration, it should be noted that this problem has been a long-standing challenge in the Database Community. However, the issue of rulebase integration is even more complex. A rule contains a head and a body, which are a consequent (conclusion) and an antecedent (condition), respectively. When the body is empty (i.e., no condition), the rule becomes a fact. Database integration [1, 8, 18] mostly deals with such facts in the form of relational tables. Therefore, databases integration can be regarded as a special case of rulebase integration.

Although more work has been done in database integration, there is a growing body of research focusing on rulebase integration. Three examples follow. In [6], early literature on modularity in logic programming was surveyed, where a program (rulebase) can be regarded as a combination of separate and independent components (modules). The classification in their paper is based on two main streams. An integrated program can either be formed based on the construction of an algebra, which links operators of subprograms, or be defined as linguistic extensions (abstraction) of Horn clauses. In [10], the authors gave some reasons for the need of rule interoperability and discussed some basic requirements that a language for interoperability must satisfy for broader use. In [14], the authors strived to use SWRL as a platform language for rule and ontology integration. They provided a homogeneous rule and ontology integration environment, where third party rule engines can be plugged-in. However, in their system, the interoperability was done on the API level. The extension and the interaction of the systems with other non-API rule-based systems, therefore, need to be further invested.

In this chapter, we propose a classification, framework, and issues of rulebase integration as needed for eCollaboration. This will provide a better understanding of, and a foundation for further development in, rulebase integration. Along with the classification, we discuss the difficulties of handling conflicts between rulebases and suggest various solutions for them. Based on the classification, we propose a general framework for rulebase integration, which includes both *rulebase interoperation* and *rulebase interchange* in the sense of the distinction proposed by Allen [15] and the W3C RIF group [17]. In the interchange approach, we use homomorphisms to preserve the semantics of rulebases before and after transformation. When transforming a rulebase from a source language to a target language, sometimes we need to split this rulebase into several parts and interchange the maximum subset of the rulebase that is compatible with the target rule engine. Another key topic of rulebase integration is how to represent constructors, user-defined, and built-in functions in rulebases while transporting them on the web. Our solution is to serialize these functions by Functional RuleML [4].

Section 2 classifies rulebase integration. Section 3 presents a framework for both rulebase interoperation and rulebase interchange. Section 4 discusses issues of rulebase interchange. We emphasize the need for preserving the semantics of a rulebase before and after transformation as well as suggest a technique for serializing functions on rulebases. Results on experiments for transforming between rule languages are also given.

1. A Classification of Rulebase Integration

We classify rulebase integration based on two dimensions: surface syntax and expressive(ness) fragment. Heterogeneous rulebases can be serialized in different languages and use various fragments of expressiveness. The following diagram (Figure 1) shows our principal classification of rulebase integration.

In the top-most level, the integration is divided based on the differences of incoming rule languages (i.e., a fixed surface syntax vs. different surface syntaxes). Since rulebases of heterogeneous rule languages can be transformed into a canonical form, the work of rulebase integration involving different surface syntaxes can be achieved by that of rulebase integration using a fixed surface syntax after a syntactic conversion is applied for these different surface syntaxes. The next sections present the classification of rulebase integration in detail.

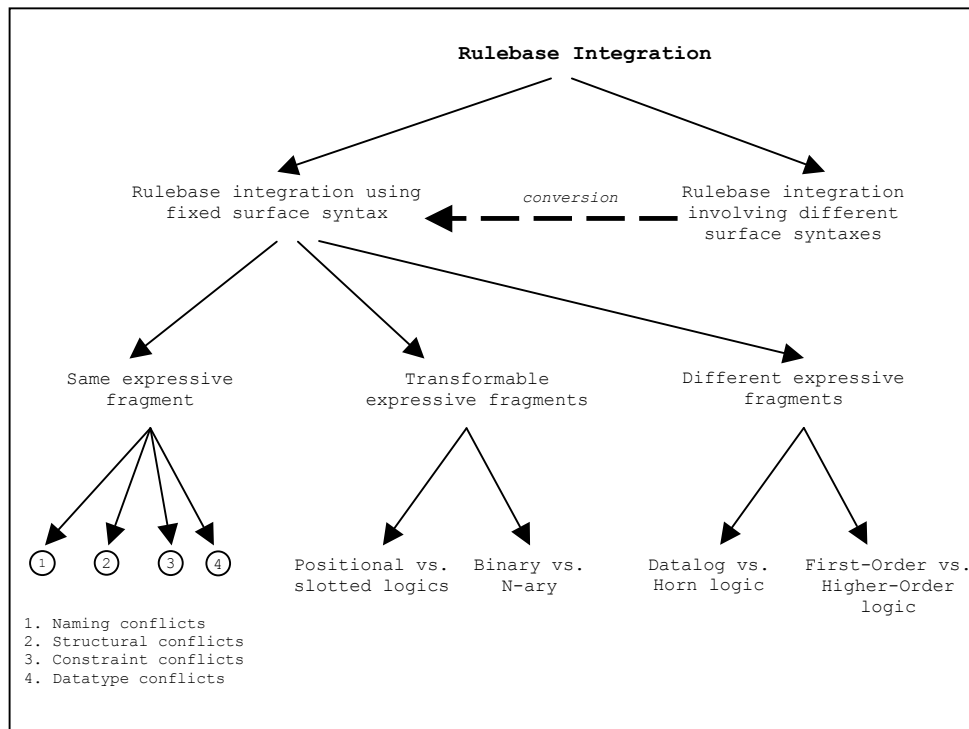


Figure 1. Classification of rulebase integration

1.1. Integration of Rulebase Using Fixed Surface Syntax

Integration of rulebases of fixed surface syntax can be subdivided into three sub-scenarios: Integration of rulebases having the same expressive fragment, integration of rulebases having transformable expressive fragments, and integration of rulebases having different expressive fragments.

1.1.1. Integration of Rulebases Having the Same Expressive Fragment

Rulebases, even serialized in the same surface syntax and having the same expressiveness, are often heterogeneous. The reason is that different rulebase providers have different perspectives about an issue. Therefore, the key issue of rulebase integration is to reconcile conflicts between various rulebases. Conflicts are classified into four main types: *Naming conflicts*, *structural conflicts*, *datatype conflicts* and *constraint conflicts*. In this chapter, we only discuss naming conflicts, structural conflicts, and datatype conflicts. For work on constraint conflicts and their resolution see [7, 8].

a. Naming Conflicts

There are two main different types of naming conflicts, namely *synonyms* and *homonyms*.

Synonyms: When two different terms (i.e., relations in rules) refer to the same real world object or concept, they are known as synonyms. For example, a merchandise in an eBusiness application is declared by a rulebase provider R_1 as follows:

```
RB1
merchandise(X) :- provider(Y,X), warehouse(Y,Z).
provider("Compact Corp.", "Printer").
warehouse("Compact Corp.", "Boston").
```

This Datalog rulebase contains a rule and two facts. The rule specifies that merchandise X is provided by provider Y from the warehouse Z. Here uppercase letters (e.g., X, Y, Z) represent variables. On the right-hand side of the symbol ":-", (i.e., `provider(Y,X), warehouse(Y,Z)`) is the body (condition) while on the left-hand side (i.e., `merchandise(X)`) is the head (conclusion) of the rule. The condition can either be an atom or a conjunction of atoms while the conclusion can only be an atom. However, from the point of view of another rulebase provider R_2 , the above merchandise can be formalized as follows:

```
RB2
item(X) :- supplier(Y,X), store(Y,Z).
supplier("Compact Corp.", "Printer").
store("Compact Corp.", "Boston").
```

Intuitively, these two different rulebases, RB_1 and RB_2 , have the same semantics. The only difference is that the relations of RB_1 (`merchandise`, `provider`,

warehouse) and RB_2 (item, supplier, store) are expressed in different terms which, however, are synonyms. However, since rule interpreters are not as intelligent as humans, these two rulebases are considered different. Usually, a term dictionary would be provided for one to one transformation between relation names.

Relation subsumption

Let us consider two relations, namely P and P' , of two different clauses, L and L' respectively.

Defintion 1

Let P and P' be two relations. P and P' are 'subsumption- interoperable' if they are on the same path in a relation hierarchy diagram (relation 'taxonomy'), i.e., a relation node is a parent (child) node of another relation node.

For example:

P = merchandise
 P' = product

and based on information in RDFS (Figure 2), we have merchandise is subClassOf of product, which could be written as the following second-order facts: `subClassOf(merchandise, product)`. We can then conclude that P and P' are subsumption-interoperable.

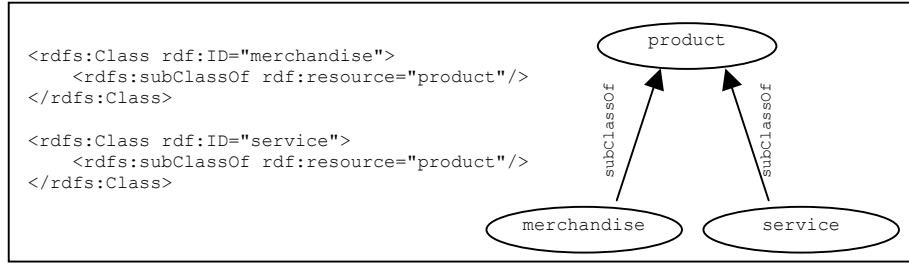


Figure 2. Relation taxonomy

Taxonomies can also be represented as rules of the following very special first-order Horn form for each pair P, P' such that `subClassOf(P, P')` holds:

$P'(X) :- P(X).$

For example `subClassOf(P, P')` becomes:

`product(X) :- merchandise(X).`

Definition 2

Let P and P' be two relations. P and P' are 'sibling-interoperable' if they are not on the same path in a relation taxonomy but have a common ancestor relation.

For example:

```
P = merchandise
P' = service
```

Based on the information in the taxonomy (Figure 2) merchandise is subClassOf of product and service is subClassOf of product; we then conclude that P and P' are 'sibling-interoperable'. However, one may argue that all the nodes in a taxonomy-tree have a common ancestor node (i.e., root node). Therefore, P and P' are considered only 'sibling-interoperable' if the *taxonomic similarity* between them does not exceed a threshold. Work on measuring the similarity between terms in a taxonomy has been done in [2, 13].

Homonyms: When the same terms (e.g., relations in rules) refer to different real world objects or concepts, they are known as homonyms. For example, the following rule defines the occurrence of an item in a list:

```
item(X) :- list(Y,X).
```

Obviously, item here is different from item in RB_2 . This is called the homonym conflict for item. There are several techniques to detect homonym conflicts. First, we can examine the arities of relations that have the same name. Two or more relations P with different arities can be resolved into different relations (relations $P/0, P/1, P/2, \dots, P/n$). For example, merchandise/1 and merchandise/2 would be different relations, so there is no homonymity problem for them. Second, we can also further check the datatypes of arguments in homonymous relations. Finally, we can investigate the equivalence of the body relation calls in two rules containing homonymous relation in the head. For example, we can try to determine that `list(Y,X)` and `supplier(Y,X), store(Y,Z)` are not equivalent. The more criteria we use, the more information we have to resolve conflicts between relations accurately.

b. Structural Conflicts

Different rulebase providers formalize an issue in a different number of rules and each rule may have a different structure. For example, a rulebase provider R_3 can declare item for the rulebase RB_3 as follows:

```
RB3
item(X) :- from(Y,X,Z).
from("Compact Corp.", "Printer", "Boston").
```

Here, from in RB_3 is the aggregation of *supplier* and *store* in RB_2 . In this case, a comparison between RB_3 and RB_1 is much harder than that between RB_2 and RB_1 . Besides the *aggregation* conflict, other subtypes of structural conflicts such as *missing-item* and *generalization/specification* found in database integration [7, 8] also occur here. The resolution for these types of conflicts can be adapted from those of database integration approaches [7, 8].

c. Datatype Conflicts

An important criterion for verifying whether two relations match or not is the matching of the datatypes of their arguments. Since relations often go with arguments, the opportunity for interoperability between two relations, namely H and H' , will be higher if there exist some relationships between the datatypes of their arguments (we will use the notation `argument:datatype`)

For example:

```
H = merchandise(X:Machinery)
H' = product(X:Tools)
```

Suppose that we are uncertain whether H matches H' or not. There may exist some metadata represented in terms of RDFS (Figure 3) about the relationship between *Machinery* and *Tools* as follows:

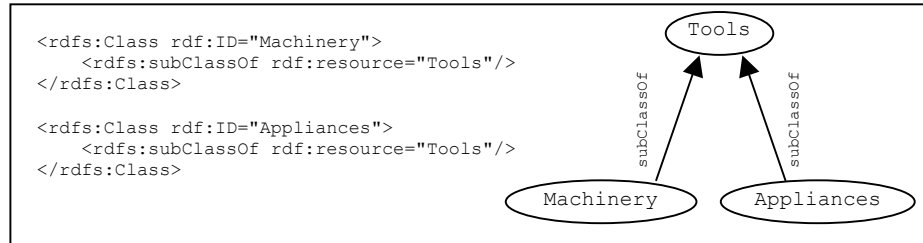


Figure 3. Taxonomy about relationship between objects

which means *Machinery* is *subClassOf* of *Tools*. We can then conclude that H matches H' since their relation names are '*subsumption- interoperable*' and the datatype of the argument in one relation is related to or matches that of the other (i.e., *Machinery* vs. *Tools*).

1.1.2. Integration of Rulebases Having Transformable Expressive Fragments

Different rulebases can interchange their transformable expressive fragments. We classify the integration of rulebases having transformable expressive fragments into two main types, namely *positional vs. slotted logics* and *binary vs. n-ary relations*. In this chapter, we only discuss the positional vs. slotted logics of Figure 1.

Positional vs. Slotted Logic

A piece of information can be presented in either a slotted logic language or a positional logic language. For example, a statement:

"John pays three hundred US dollars for his meal"

is represented in the slotted style of POSL¹ as follows:

R_{slotted1}
pay(buyer->"John"; item->"meal"; USD-price->300).

But when these data are positionalized, they become:

R_{pos1}
pay("John", "meal", 300).

Obviously, with the slotted representation, data can be described in a more semantic way with additional information carried on by slots. When integrating positional and slotted rulebases, there is a certain risk, by which information can be lost or need to be fulfilled by the system. For example, consider a rule **R_{slotted2}** as follows:

R_{slotted2}
pay(buyer->"John"; item->"meal"; CAD-price->300).

which means that

"John pays three hundred Canadian dollars for his meal".

If **R_{pos2}** is a positionalized version of **R_{slotted2}**, it will become:

R_{pos2}
pay("John", "meal", 300).

¹ <http://www.ruleml.org/submission/ruleml-shortation.html>

Here, even though R_{slotted1} and R_{slotted2} are different, their respective positionalized versions are the same. This is due to a certain amount of lost information (metadata) when we transform from a slotted logic language to a positional logic language. In the opposite direction, from a positional logic language to a slotted language, additional information must be provided. For example, when transform R_{pos2} to a slotted version, we will not know exactly what should be the appropriate slot name for each data item. Thus, slotted versions of R_{pos2} can be R_{slotted1} , R_{slotted2} or others. A possible solution for this problem is that instead of removing slot names when we positionalize rulebases, we could keep them in the form of *Signature* declarations [5, 9] for further use.

1.1.3. Integration of Rulebases Having Different Expressive Fragments

Rulebases of the same language can also be expressed in different fragments of expressiveness. In some family languages, such as RuleML, a rule can be from the lowest fragment of semantics, namely *binarydatagroundfact* (fact in a binary format), to the highest fragment of semantics, namely *naffologeq* (first-order logic with negation of failure and equality). Therefore, when integrating rulebases having different expressive fragments, we need a mechanism to utilize the maximum subset of these two rulebases. Basically, rulebase integration of different expressive fragments can be classified into two main types, namely *Datalog vs. Horn logic* and *FOL (First-Order Logic) vs. HOL (Higher-Order Logic)*. Due to space limitations, only the issue of Datalog vs. Horn logic of Figure 1 is discussed.

Datalog vs. Horn logic

Different users can formulate their rulebases with different level of semantics from the same issue. Returning to the previous example *merchandise*, a rulebase provider R_4 can express his rulebase RB_4 as follows:

```
RB4
merchandise(X) :- provider(company[Name, Loc], X),
                  warehouse(Name, addr[Street, City]).
provider(company["Compact Copr.", "USA"], "Printer").
warehouse("Compact Copr.", addr["23 Main Street", "Boston"]).
```

Unlike RB_1 , RB_2 and RB_3 , which are serialized in Datalog, RB_4 is represented as a set of Hornlog rules. In general, the two following situations can occur:

(1) A less expressive rulebase R (e.g., in Datalog) is sent to a more expressive rule engine E (e.g., built for Hornlog) to be executed. In this case, the engine E can naturally handle R , although the engine E may not be efficient for this special case.

(2) A more expressive rulebase R (e.g., in Hornlog) is sent to a less expressive rule engine E (e.g., built for Datalog) to be executed. In this case, the engine E cannot handle R . However, splitting rulebase can be used to at least interchange the maximum subset of rulebases that is not more expressive.

Returning to our example, if RB_1 , RB_2 and RB_3 are sent to a Hornlog rule engine, which is able to handle RB_4 , they can be executed naturally. However, the opposite direction does not work since a Datalog rule engine, which is able to handle RB_1 , RB_2 and RB_3 , cannot handle a Horn rule RB_4 .

2. Rulebase Integration Framework for Interoperation and Interchange

From the classification in the previous part, we see that distributed rulebases are heterogeneous in terms of different languages and levels of expressiveness. Based on that classification, a framework for rulebase integration, as rulebase interoperation and rulebase interchange, is proposed. Figure 4 shows a framework for rulebase integration. There are several different kinds of rulebases in this framework. We use traditional rule languages such as F-Logic [9], Prolog [16] and Relfun [3] to describe three participating legacy rulebases, and we use XDD [22] and RuleML, two XML syntax-based rule languages, to model two other participating rulebases. These rulebases are distributed and heterogeneous in both languages and levels of expressiveness but their expressiveness are also intersected.

In our framework, rulebase integration can be done by either interoperation or interchange. While interoperation (bold dashed-dot-dot line) supports query transformation, distributed querying, and answer composition for distributed (and often autonomous) rulebases, interchange (bold dashed line) transforms heterogeneous rulebases into a canonical form, thus supporting uniform querying. For example, a user's query, in terms of RuleML, asks for data from these existing rulebases. Using the interoperation approach, the system both queries the RuleML rulebase locally and sends this query to the distributed rulebases (e.g., F-Logic rulebase, Prolog rulebase, Relfun rulebase, and XDD rulebase). Data extracted from these distributed rulebases are composed and returned the final results to users. Using the interchange approach, the system first analyzes all the existing rulebases, imports, transforms them into a canonical form and stores them into a central rulebase (e.g., RuleML rulebase). This process is done one and for all. Whenever users pose queries, these queries will be processed locally in the canonical rulebase. With the difference between interoperation and interchange, we find that the classification of rulebase integration (in Section 1) is applicable only for interchange approach, where differences of surface syntaxes and expressive fragments are analyzed.

In the interchange approach, transformation can be done declaratively by using transformation rules, which themselves are interchangeable. This transformation can be total or partial, in that information may be preserved or lost through the transformation. Section 4 will discuss this issue in more detail. In the interoperation approach, an input query is decomposed into subqueries for execution in distributed rulebases. Answers from those local rulebases are then composed into a global one and returned to users. By following the interoperation approach, rulebases can be kept unchanged and executed in an

environment best suited for a specific (sub)task but queries have to be processed (repeatedly). By following the interchange approach, entire heterogeneous rulebases have to be transported and transformed into a homogeneous form (once), but this facilitates uniform querying and optimization. The following section will focus on rulebase interchange, but we refer to [19, 20] for details on rulebase interoperability.

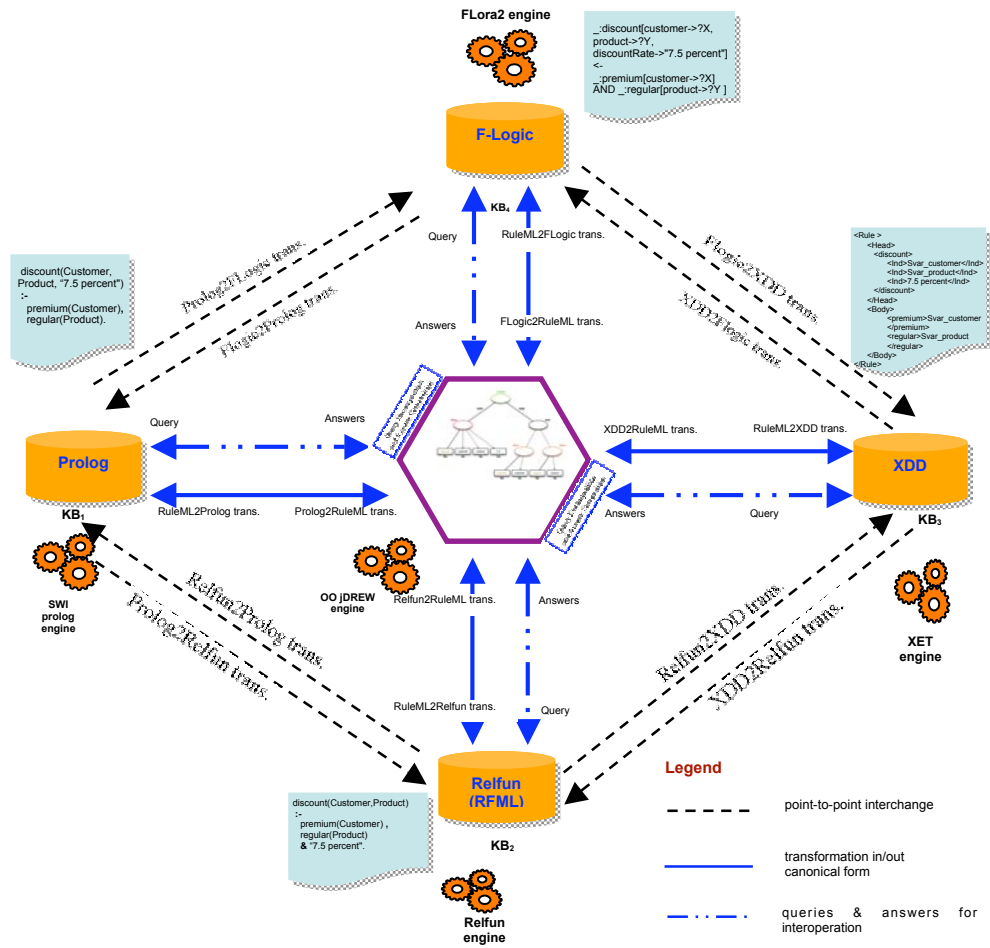


Figure 4. Framework for rulebase integration

3. Issues in Rulebase Interchange

This section will discuss semantics-preserving transformation and serializing functions, two important issues of rulebase interchange as well as give initial experimental rulebase interchange results.

3.1. Semantics-Preserving Transformation

When transforming a rulebase encoded in (the surface syntax of) a language to another language, an important issue is how to preserve the semantics of that rulebase. Ideally, information is preserved during transformation. However, in some situations, we have to accept *lossy transformation*, which means that some information may be lost during a transformation of a rulebase from a rule language to another one. Figure 5 shows a commutative diagram of rulebase transformation corresponding to the XDD \rightarrow RuleML interchange of Figure 4. If `trans` is a transformation function from XDD to RuleML, we want to have `trans` as a homomorphism yielding the following commutative diagram:

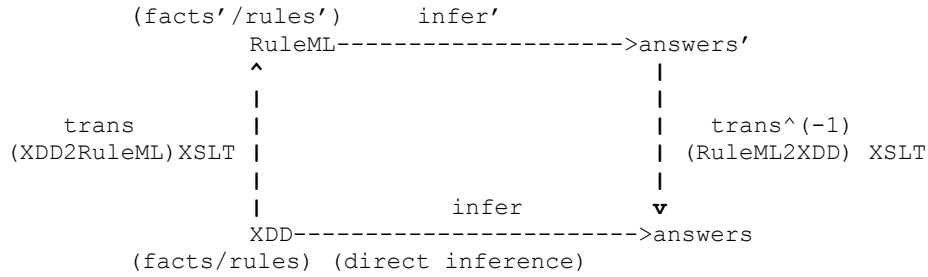


Figure 5. Commutative diagram of rulebase interchange

In this commutative diagram, the answers of the indirect inference and those of the direct inference should be equivalent. This means that `facts/rules` after having sequentially applied `trans`, `infer'` and the `trans` inverse `trans(-1)` should produce the same answers as when having applied `infer` directly. The above diagram can thus also be expressed by the following formula:

$$\text{trans}^{(-1)}(\text{infer}'(\text{trans}(\text{XDD}))) = \text{infer}(\text{XDD})$$

Errors can appear in either of the two paths: `trans` \rightarrow `infer'` \rightarrow `trans(-1)` or in `infer`. However, if the source language and the target language (in this example, they are XDD and RuleML respectively) are based on perfect rule engines, then the possibility for errors occurring in `infer` and `infer'` is zero. Thus, `trans` and `trans(-1)` are the places where errors have occurred.

3.2. Serializing Functions

Most existing languages, including Functional Programming, Logic Programming and Functional Logic Programming Language, employ some versions of functions (constructors, built-in or user-defined functions). Therefore, there arises a need for representing functions while exchanging them on the Web. This can be benefit from Functional RuleML [4], a newly derived sublanguage of the RuleML family language since at the end of 2005. In Functional RuleML, a function can be interpreted, uninterpreted or can even be semi-interpreted for flexibility. For example, if the function of the term `addr(Street, City)` is uninterpreted, the term just denotes the data structure consisting of its *constructor* `addr` applied to its arguments `Street` and `City`. We will emphasize this by using Relfun-like square brackets as in `addr[Street, City]`. The example can thus be marked up as an uninterpreted function (`in="no"`) as follows:

```
<Expr>
  <Fun in="no">addr</Fun>
  <Ind>Street</Ind>
  <Ind>City</Ind>
</Expr>
```

Moreover, since higher-order functions are implemented in many rule-based systems, it is reasonable for Functional RuleML to support them. For example, the following function `CustomerAffiliation` takes the `addr` and `email` functions as its arguments. Since functions (`addr` and `email`) here play the role of arguments of another function (`CustomerAffiliation`), this is a higher-order function, specifically a higher-order constructor.

```
CustomerAffiliation[addr, email].
```

The markup version of the `CustomerAffiliation[addr, email]` application is as follows:

```
<Expr>
  <Fun in="no">CustomerAffiliation</Fun>
  <Fun in="no">addr</Fun>
  <Fun in="no">email</Fun>
</Expr>
```

By using RuleML consisting Functional RuleML as a canonical form for rulebase integration, we can naturally handle the problem of function representation and interchange.

3.3. Experimental Results

We have developed some XSLT stylesheets to transform between rulebases of RFML and RuleML, RuleML and XDD.

3.3.1. Interchange Between RFML and RuleML

In August of 2005, a `RFML2RuleML.xslt` stylesheet [11] was developed by Jie Li to transform the logical part of RFML (Hornlog RFML) to RuleML 0.89. A usecase, namely Chemical XML Elements (ChemXelem) [11], containing information about all chemical atoms, was used to verify the correctness of the transformation. With the incorporation of Functional Programming into RuleML, a second stylesheet [4] was written to transform the functional part of RFML to RuleML (i.e., Functional RuleML). Similar to the earlier stylesheet, numerous examples were used to verify the correctness of the transformation. Using these two stylesheets, users can transform a whole RFML program consisting of functional and logical parts to RuleML.

3.3.2. Interchange Between XDD and RuleML

RuleML is a very powerful logical/functional language which can describe Datalog, Horn logic, first-order logic as well as higher-order logic. Because of its popularity, RuleML has become a candidate for a standard rule representation on the web. However, it still lacks the capability of modeling user-defined XML documents. On the contrary, XDD has an expressive power on modeling XML documents but it cannot compare to RuleML about the mathematical and computational power. Therefore, by interchanging rulebases of these two languages, these rulebases can first be processed in one environment before passing to the other to process. We can thus exploit the power of both RuleML and XDD. However, since the expressiveness of the two languages is not the same, therefore the transformation here is the only `partial` transformation. Two stylesheets to transform from XDD to RuleML and vice versa were implemented in `<http://www.ruleml.org/usecases/XDD/>`.

Conclusions

Rulebase integration has recently gained a lot of attention since it is a basic problem underlying many Semantic Web applications, such as in eCollaboration, enterprise information integration, and semantic query processing. In this chapter, we defined the objects and vocabularies of eCollaboration by rules (including taxonomies). We propose a classification of rulebase integration discussing the conflicts of each classification in detail. Several earlier techniques for database integration can be applied to rulebase integration since the former can be regarded as a special case of the latter. From the classification, we presented a unified framework for rulebase integration containing both the interoperation and interchange approaches. Using our framework, a rulebase can be interoperated unchanged (to accommodate legacy rulebases and permit decentralized inferencing) or interchanged via a canonical form before possibly merging them with other ones (to

simplify future processing and permit uniform inferencing). We discussed the interchange homomorphisms for preserving the semantics of rulebases on transformation. The integration of various function types in rulebases is enabled by Functional RuleML. Finally, XSLT stylesheets to transform between RFML and RuleML, between XDD and RuleML led to initial interchange results.

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An Adaptive Visual Interface for Collaborative Knowledge Communities

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Abstract: This chapter introduces a memetic visual interface (InOrder) supported by stigmergic knowledge foraging strategies which enables automated creation of virtual collaborative communities of like-minded thinkers in Cyberspace. A synergistic process of knowledge elicitation and conceptual navigation supports continual, high-level evaluation of search progress towards optimal keywords related to the domain of interest which enables teams of searchers interested in the domain at stake to dynamically establish an optimality of meaningful collections of search strategies that ultimately result in relevant knowledge of common interest to the particular community emerged as a result of this process. Cognitive and biological mechanisms observed within social insect systems are used to guide attention towards relevant domain concepts, and this supports conceptual learning and sense making even if queries aren't constructed. Incremental interaction automatically creates maps of associated keywords, and this helps InOrder overcome the "knowledge acquisition bottleneck". Retrieval systems such as Google return authoritative pages matching a query but do not assist requirements specification. InOrder offers such support, assisting the formation of more precise queries when goals require clarification. This keyword recommendation approach enables InOrder to improve the performance of existing search engines and deliver more relevant results to users.

Keywords: collaborative communities, Cyberspace, knowledge foraging, search engine, information relevance, query refinement, adaptable visual interface, memetics.

Overview

InOrder (Fig. 1) – www.InOrder.org - is an adaptable visual interface for collaborative search and query reformulation. It is designed such as to create a natural language interface supporting query refinement. Users simply click on anything that seems relevant, and this elicits conceptual refinements and reduces the rating effort required within many collaborative systems. Since it takes less effort to click than type, this reduces both cognitive and physical costs associated with supplying preference, which encourages

participation. Information presentation has also been designed to reduce eye and mouse travel as well as feedback effort when performing conceptual exploration.

As Figure 1 illustrates, in many ways InOrder functions as a "visual search WIKI" (<http://www.wikipedia.org/>) which represents search *intent* rather than search of formal articles. InOrder's compos-able query interface encourages users to select keywords to narrow their search, simple selective acts which assist personal search goals while refining a search group. Every action is a refinement offering both personal and collaborative benefit, where personal benefit refers to guidance towards *real* Information need (as opposed to *perceived* information need) as per [6], while collective benefit refers to better characterization of a search domain.

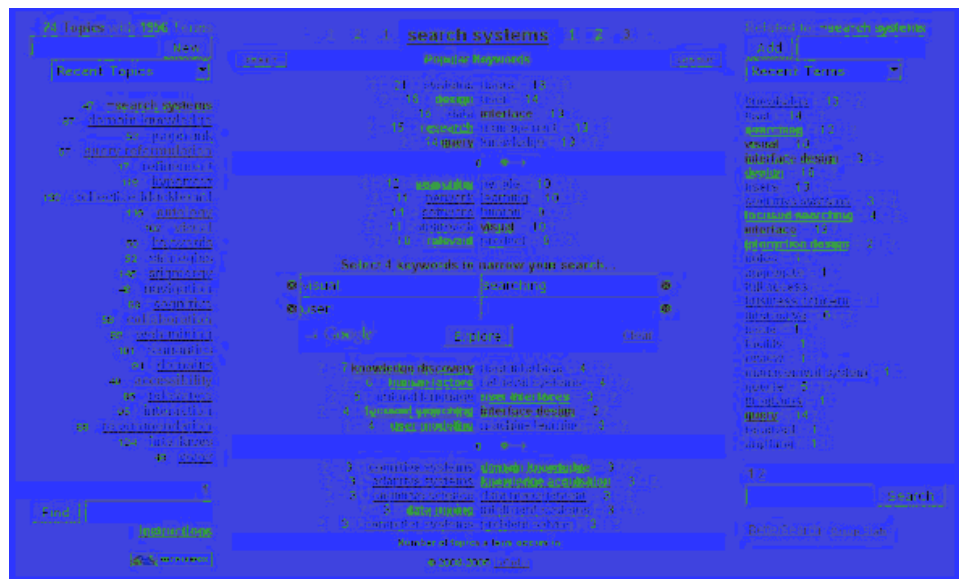


Fig. 1: In Order's Visual Interface

1. Design Principles

As seen in Figure 2, InOrder integrates research into Search Usability, Data Mining and the Semantic Web within a collaborative visual interface.

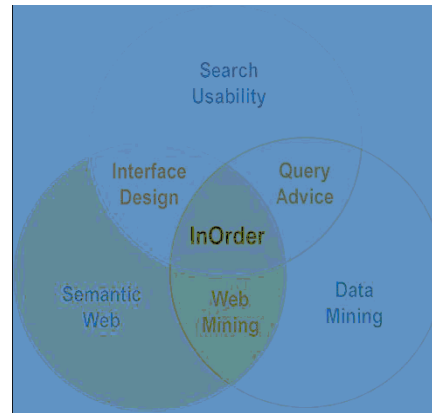


Fig. 2: How In-Order Relates to other Web research

This integration is motivated by the premise that while the current vision of a Semantic Web built using XML is a valuable one, most research currently focuses on knowledge representation issues rather than interface development. And since most of the web currently consists of unstructured HTML content, this suggests that interfaces that facilitate cooperative translation of unstructured content into structured formats could be of considerable value. InOrder focuses on this interface-centric aspect of Semantic Web design, using an interactive data mining approach to extract meaningful (i.e. “semantic”) data from unstructured HTML into InOrder's semantic framework. This web-mining approach enables InOrders keyword recommendation service, and in turn assists the refinement of broad or complex search tasks. Explicit keyword selection validates keyword utility within a given context, so search groups may converge towards more useful semantic structures as interaction occurs. This approach to semantic collaboration helps users explore relevant semantic knowledge when clarifying queries, and builds structured knowledge bases that may support other Semantic Web tools.

To achieve this, InOrder was designed according to the following principles:

- The interface should be platform independent to improve accessibility. This prompted use of server-side PHP solution which supports any forms-capable browser. Barriers to entry are reduced by avoiding signup, login or submission of any personal information.
- Use adaptive hypertext to structure the process of query reformulation. The system should log search tasks within the appropriate context and aggregate relevance opinions from individual users into a shared repository. This semantic blackboard with visual markup should behave in a stigmergic manner.
- Encourage explicit semantic interaction to ensure contributions are consistent and meaningful. A single click should perform actions which offer both personal and collective benefits, such that users participate in a process of conceptual design as they refine personal queries. This will allow casual participation to construct meaningful search maps.

- Prompt selection and evaluation of concepts before pages to assist accurate requirements specification. This is achieved through interaction design which conducts semantic search in parallel with document search. Web mining also supports this procedure, by incrementally extracting relevant keywords from relevant search results.
- Employ the principle of *direct manipulation* to increase system comprehension and motivate participation. All information should also be presented in a manner that assists visualization of recent interactions and fosters a sense of contribution.

2. System Goals

To successfully implement the system described above, InOrder defines several goals and design criteria which will provide users with an improved search experience when requirements are unclear:

1. Improve search usability for people with vague or complex search goals.
2. Guide the search process, and reduce time required to accurately specify search requirements.
3. Provide a consistent interface to refine and expand queries, which will improve search result relevance.
4. Recommend useful terminology to increase awareness within a domain as search occurs. This leads to longer and more specific queries which produce more relevant Google results.
5. Help users visualize domain knowledge, so relevant terms may be recognized and utilized more rapidly. Visual states should reflect prior feedback from like-minded searchers within the context (ie. search group), so searchers may effectively \see the insights of others.

3. InOrder's Foundational paradigms

In-Order operates on the following paradigms of complex adaptive systems functionality:

3.1. Direct Visual Manipulation

As mentioned above, one technique employed by InOrder to increase usability of the blackboard interface is an interaction style called direct manipulation. Shneiderman [8] points out that this approach to user interface interaction usually leads to more usable interfaces, and InOrder allows direct, visual manipulation of all semantic knowledge within a search group. Shneiderman [8] also notes that one of the reasons for the success of direct manipulation interfaces is that visibility of objects of interest enable interaction close to the high-level task domain. Users don't need to decompose tasks and figure out what is going on, they simply interact and receive immediate feedback on the outcome of each action. Each act produces a comprehensible result in the task domain whose effect is immediately

visible, reducing user anxiety because the system is comprehensible and actions are easily reversed. This interactive approach elicits meaningful semantic knowledge while helping users understand the purpose and benefits of participation. Direct manipulation supports stigmergic coordination of InOrders' semantic collections. Each click or vote creates immediate visual notification confirming interactive intentions were met. Combined with visual presentation which reflects relevance, this facilitates dynamic visualization of search domain concepts and offers a simple and meaningful way to explore the search advice of others. Ideas are explored before pages, establishing visual semantic trails which adapt to reflect search intent. This technique also preserves a user's sense of control and contribution, to enable participation without personalization.

3.2. Orienting Response and Information Scent

In the context of human experience, the Orienting Response (recognized by the Russian physiologist Sechenov in the 1850s, and studied extensively by Ivan Pavlov in 1927) explains why moving objects attract our attention. Early humans took advantage of this reflex not only to hunt and avoid predators, but also to detect fire, lightning and other environmental threats. Colours such as blue or green which are common in nature evoke the least response, whereas rare ones such as yellow or red draw greater levels of attention. Within modern society such behavioral reflexes now also affect activities such as driving automobiles or watching television. Consideration of the Orienting Response has guided the design of red traffic lights, yellow highlighters, terrorist alert systems and television ads, each in an attempt to provide novel stimuli which gain and hold human attention. InOrder instead applies this principle to the exploration and markup of keyword repositories which assist query refinement. Much like ants modify their behavior in response to chemical scents, colouration within InOrder guides the eyes and thus use of suggested semantic information. By combining the visual Orienting Response and the principle of Stigmergy within a simple interface, InOrder facilitates visualization of relevant conceptual information and perceptually guides information foraging activities.

An example of such markup invoking the Orienting Response is illustrated in Figure 1. Brighter terms such as green or yellow ones draw more attention because they have been voted up most often, suggesting they were useful in the past. Such cues direct attention towards promising semantic information within a given context, and support the selective process during query reformulation. This approach is based upon Chi and Pirolli's work on Visual Information Scent and Searching [1]. Visual markup informs users of the Information Scent of potential refinements, with 7 colours and 7 relevance states providing attention guidance. Terms with greater utility within a context influence future exploratory efforts simply because they are noticed more often.

In short, the colour draws attention to most relevant information so time is spent exploring the most promising options. Similar to the cognitive maps formed via pheromone trails in ant colonies, the perceptual semantic interface guides conceptual exploration, and explicit semantic use/voting (i.e. explicit moderation) maintaining the relevance of shared semantic structures. This indirect communicative approach enables self-organizing semantic repositories to emerge from query interaction as per Section 4.4.

3.3 InOrder as a Memetic Algorithm

InOrder behaves much like a memetic algorithm, one which adapts according to human choice rather than natural selection. InOrder achieves this by treating query terms as memes, pieces of knowledge which reside within host groups and may be utilized for search. Yet unlike societies where information is spread through selective oral and written discourse and stored within human memory, InOrder uses the open semantic blackboard to share concepts or memes in an indirect and collaborative fashion. Within this framework search interaction deposits keywords into a shared environment where they are subject to public examination and review. Contextual click frequency influences position, colour and thus adequacy of a concept, and as domain characterization occurs memes with the greatest contextual utility rise to the top.

Table 1 shows the representational analogies between genetic and memetic [4] systems and InOrder's components.

Genetic Algorithm	Memetic System	InOrder
Gene	Meme	Keyword
Chromosome	Paradigm	Topic
Population	Society	Group
Fitness	Urge to repeat	Urge to click
Initialization	Cultural Norms	Popular Terms
Selection	Most Compelling	Most Useful
Crossover	Human Discourse	Term Combination
Mutation	New Ideas	New Terms

Table 1: Representational analogies between genetic/memetic systems and InOrder

As a composable memetic interface InOrder facilitates the collection, management and reuse of search memes. The interaction design promotes incremental acquisition of useful ideas, and re-evaluation or re-combination of frequently used terms. This process becomes one of intelligent crossover and mutation as human searchers intentionally explore new conceptual terrain, and “memetic foraging” prior to document evaluation allows the keywords to emerge via cooperative selection. This creates collaborative knowledge communities, in which individuals with similar interests can easily share opinions, attitudes and ideas within a conceptual ‘commons’. Potential applications of such modes of use include collective brainstorming and strategy formation, in which the shared environment becomes a sketchpad for the exploration of related ideas. In the next section we will examine how this evolutionary/memetic framework has the potential to organize conceptual information without any central guidance.

3.4. Potential for Semantic Self-Organization

As illustrated in Table 2, InOrder's components also have direct analogies to neural and ant systems which both exhibit properties of self-organization. Like these systems, InOrder employs a swarm strategy to coordinate information exchange among system entities. Inspired by the parallels drawn between natural and information systems in [9], InOrder is designed such that actions of many independent agents lead to increasing system organization. Through cooperative memetic exchange and manipulation of textual knowledge, interacting team members may automatically adapt knowledge-bases towards representations that reflect group interests. Explicit human choice (as opposed to automatic pheromone secretion) creates persistent but adaptable semantic communities, which evolve according to collaborative selection.

Brain	Colony	InOrder
Neurons	Ants	People
Hebbian process	ACO algorithm	HBGA
Cognitive Map	Pheromonal Field	Semantic Blackboard
Learning	Foraging	Query Reformulation
Neural path	Foraging path	Semantic Search path
Activation level	Pheromone intensity	Keyword rank
Reinforcement	Deposit Pheromone	Positive interaction
Inhibition	Evaporation	Negative interaction
Perception	Chemical detection	Color draws attention
Recruitment	Move along gradient	Notice relevant terms
Associative priming	Past food discovery	Past keyword utility
Minimizes required energy	Path distance	Human evaluative effort
Efficient neural structures	Efficient food collection	Efficient search

Table 2: Analogy InOrder and other self-organizing systems

This indicates InOrder's conceptual framework has potential to form self-organizing search maps.

4. Interaction Model

Information Foraging [10] and the StumbleUpon web discovery service [11] have inspired InOrder's interaction model, Fig. 3. These two approaches improve the Standard Interaction Model by applying principles from social and biological systems to the process of information retrieval. InOrder uses a new interaction model combining aspects of Information Foraging with a hybrid rating approach found within StumbleUpon. This interaction model focuses query formation activities by recommending useful associated keywords as potential refinements.

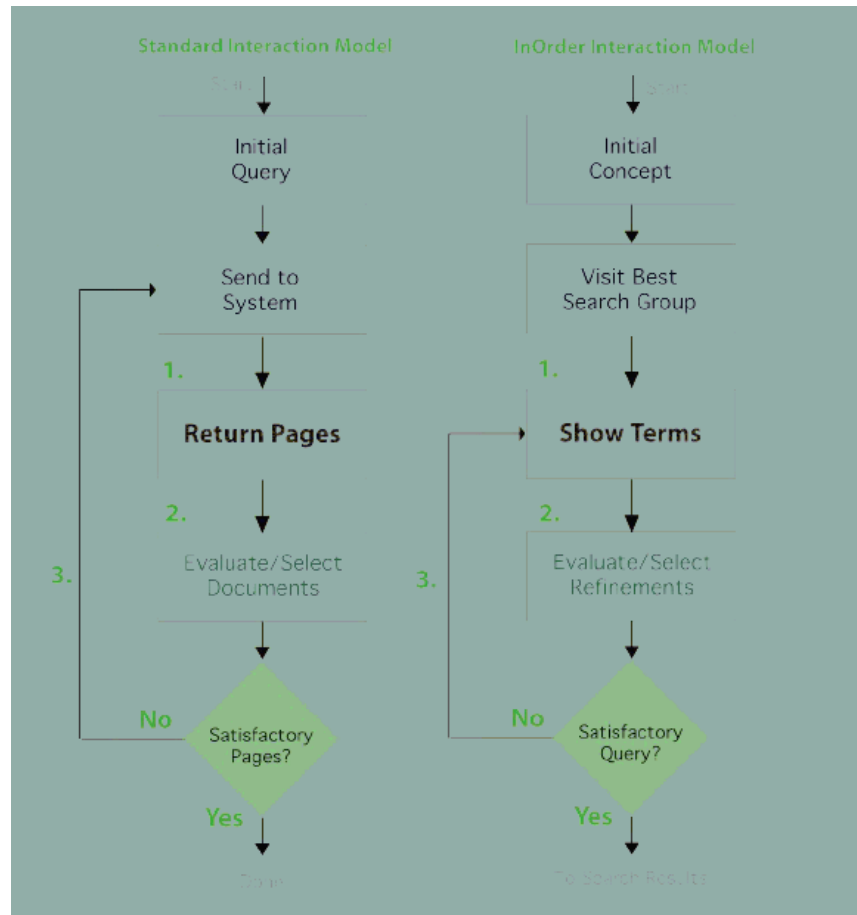


Fig 3. Standard Interaction Model vs. InOrder Interaction Model

5. System Architecture

InOrder's backend is designed such that casual interaction naturally validates and organizes semantic information into meaningful data structures. The architecture, Fig. 4, helps users incrementally focus search tasks and easily build and manage groups, which assists exploration by like-minded searchers. Within InOrder a domain is represented by a search group, a collective history of query refinements which characterize the needs of users who chose to interact with a group. InOrder utilizes such domain models to assist keyword discovery, using the visual semantic blackboards to present users with concise summaries of interaction history. This assists users when they are unsure of search requirements, as they are able to examine stereotypical selections made by others. InOrder constructs

domain models by extracting terminology from pages returned by Google, while using explicit human selection to incrementally associate keywords. This may also be thought of as search task modeling, in which search requirements are elicited from anonymous users and aggregated into contextual repositories. These models are concise and meaningful because they are formed through explicit user validation of extracted suggestions. These search ontologies do not formally specify relationships between entities, simply recording adjacent keyword selections within a given context.

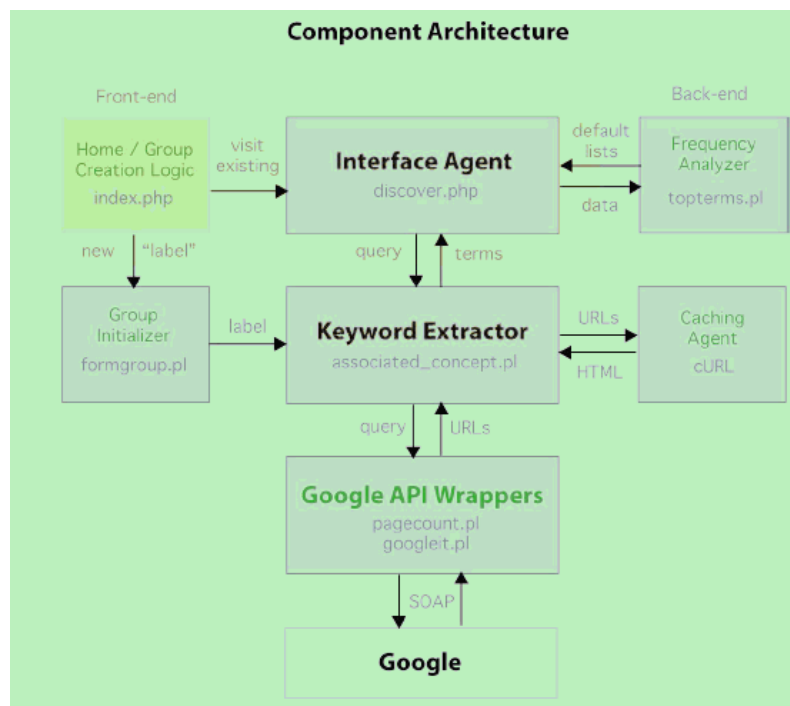


Fig. 4: InOrder System Architecture

6. Implementation

As shown in Figure 5, InOrders' visual stigmergic interface coordinates this incremental specification process.

Figure 6 illustrates the layout of the InOrder interface for 'Caribbean travel' community of interest, and describes 17 interface features. The functionality, purpose and reason behind each interface element is described from a user-centric perspective. This description matches the "instructions" link appearing at the bottom left-hand side of the interface.

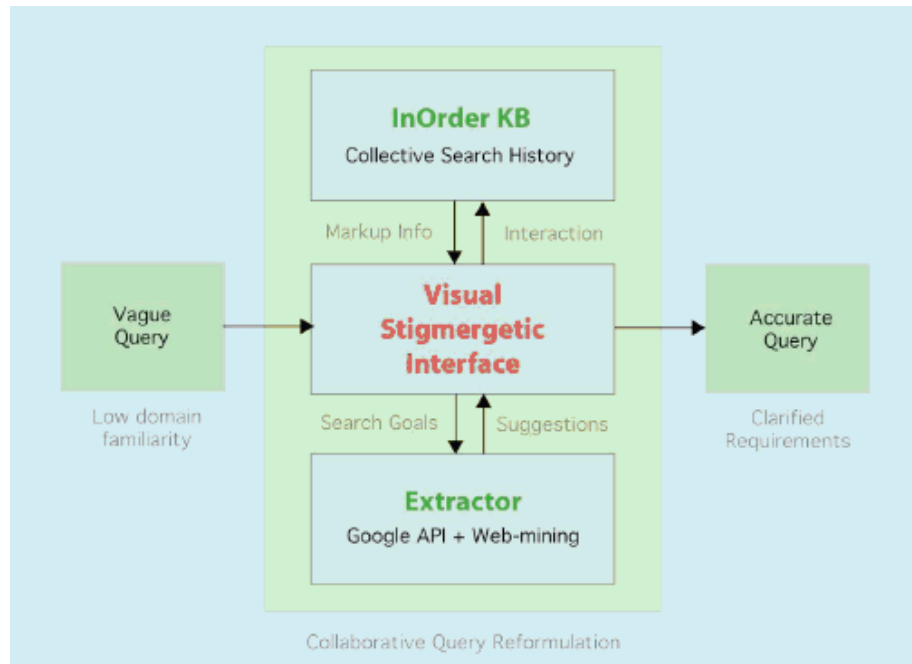


Figure 5: Conceptual Search approach

1. Suggested Words: Select any of these words to add it to your search query. Terms with higher counts and brighter colours tend to be more useful, as they have been used more frequently in the past. Here the terms 'travel' and 'caribbean' have been selected, and added to the list of recently used keywords.
2. Suggested Wordpairs: Just like words, you may select any of these to add them to your query.
3. Explore Button: Click the explore button if you've selected some terms, but would like more suggestions to further narrow a search. In this example, clicking "Explore" would suggest keywords related to traveling to the Caribbean.
4. Google Button: Once you have selected 4 keywords, you will be shown top Google results for these terms. If you don't need all 4, clicking the Google button will popup a window of results for terms you have currently selected. Feel free to delete keywords using the red X buttons.
5. Clear Button: This removes all your currently selected keywords, so you can start fresh.
6. List of Topics: These are topics within a group you may browse. Simply select the most appropriate one.

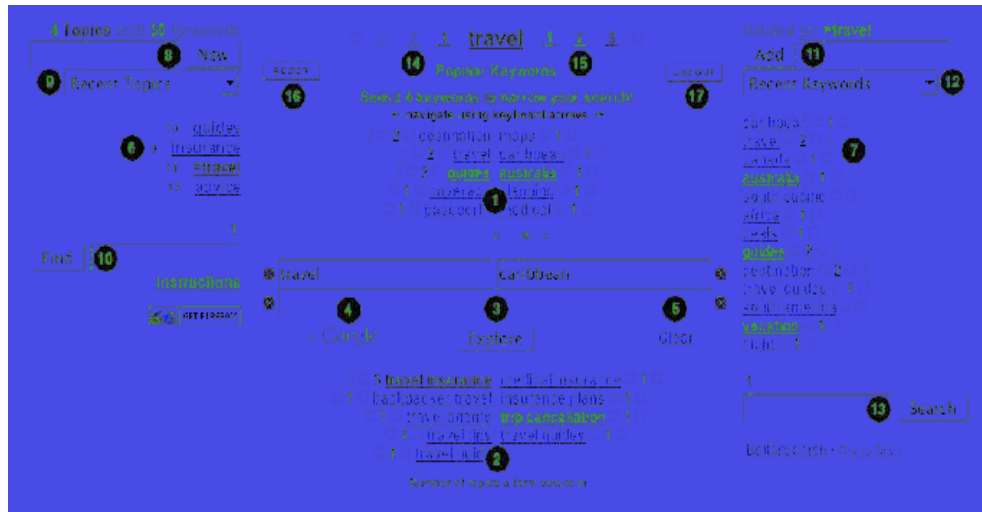


Fig. 6: Interface Layout

7. Selected keywords: These keywords have been recently used within the selected topic (in this case the default "travel" topic). Essentially this is a log of what you or others have clicked in the past because it seemed useful.
8. New Topics: If you don't see a topic that interests you, simply create one here by clicking "New".
9. Topic Sorter: You may sort the list of topics by recency (default), popularity, or alphabetically.
10. Finding Topics: If you click on a question mark next to a recently used keyword (near 7), you will be shown all the topics in the group which contain similar keywords. This helps you find related topics.
11. Adding Keywords: If you know of a keyword that is useful but not present, feel free to add it.
12. Keyword Sorter: You may sort sets of keywords in a topic by recency (default), sequence or alphabetically.
13. Searching for Keywords: At any time you may search for other keywords within the group that are related to what you are looking for. Simply type a word in here, or click a question mark next to any word/wordpair in the center section of the screen (1 or 2) this will show all similar matching keywords.
14. Useless Terms: These are terms which have been voted down within the group, so they aren't as noticeable. If you see a term which isn't helpful, simply click the minus button next to it.
15. interesting Terms: These are helpful terms which have been voted up 1, 2 or 3 times. Feel free to click the plus button next to any term which was interesting or helpful... it will then be noticed more often.

16. Reset Button: Returns you to the default group view, an overview of all popular keywords within the group. Click at any time to start a fresh search.
17. Logout Button: Takes you back to InOrder.org, where you can browse/create other groups.

Conclusions

InOrder assists the execution of vague or complex search tasks by providing a composable visual interface for semantic knowledge sharing. The collaborative search interface recommends keywords to assist query formation by extracting associated textual knowledge from authoritative search results. This allows users to improve their queries through selective use of associated terms which better specify search requirements, and helps users realize “what to search for” as recommendations are examined. Use of terminology which search peers found helpful is also possible, by examining bold keywords which peers endorsed when examining prior extracted keywords. This service of semantic recommendation prior to document retrieval causes search within InOrder to become a two stage process, in which InOrder displays aggregate semantic interaction guiding term selection behavior. Groups of searchers may use and reuse these search maps to clarify search requirements and construct better queries as they alternate between conceptual and document browsing modes. This creates open semantic indices with open reread/rewrite access in which all participants are moderators, and simple selective acts automatically improve index relevance.

Beyond its primary purpose of query refinement InOrder also functions as a collaborative interface assisting brainstorming and collaborative inquiry. The open, visual interface helps users not only gather and evaluate search strategies but also survey ideas associated with a domain. Participants may easily forage for ideas and make their opinions known by simply clicking on terms they find interesting. These semantic maps have several potential applications beyond keyword recommendation including classification, personal semantic modelling, and information filtering for e-commerce applications.

As shown in Figure 7, InOrders' anonymous, collaborative and semantic approach gives users the benefits of collaboration seen in systems such as StumbleUpon Web Discovery Service (<http://www.stumbleupon.com/>), and improves conventional search engines such as Google by encouraging exploration of concepts before pages. This knowledge acquisition strategy and semantic recommendation interface allows InOrder to integrate easily with other retrieval systems.

The semantic collections guide query formation and direct users to more relevant search results, which may then be shared with others using social bookmarking services such as StumbleUpon or del.icio.us [12]. These two approaches improve the Standard Interaction Model by applying principles from social and biological systems to the process of information retrieval. InOrder uses a new interaction model combining aspects of Information Foraging with a hybrid rating approach found within StumbleUpon. This interaction model focuses query formation activities by recommending useful associated keywords as potential refinements.

From a Recommender Systems perspective, InOrder focuses on conceptual knowledge sharing rather than document discovery. Retrieval systems such as Google return authoritative pages matching a query but do not assist requirements specification. InOrder offers such support, assisting the formation of more precise queries when goals require clarification. This keyword recommendation approach enables InOrder to improve the capabilities of existing search engines and deliver more relevant results to users.

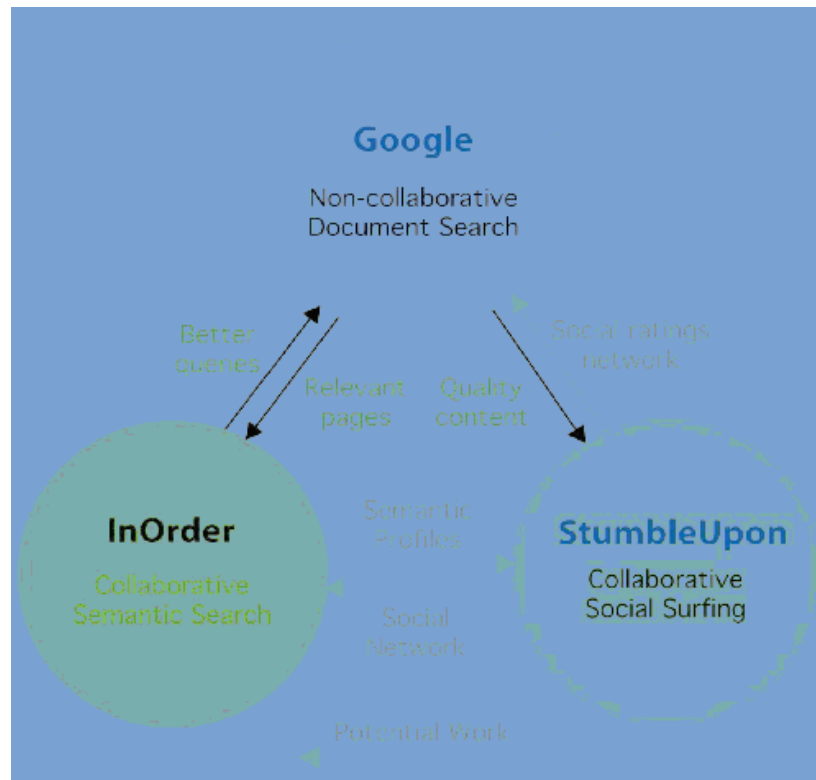


Fig. 7: InOrder in the context of today's search engines

InOrder also uses Google's API and web-mining to acquire lexical resources from over 8 billion WWW pages, rather than IBM's NetQuestion [4] which queries smaller, more specific document collections. This endows InOrder with better usability and greater flexibility. InOrder encourages collaborative, visual evaluation of semantic relevance which further assists comprehension and scanning of vocabulary. Visual relevance moderation is possible after keyword extraction, allowing participants to validate and reuse only the most useful keywords within the open knowledge bases. This enables the quality of InOrder groups to improve as participation increases, as collective and synergistic organization emerges from personal query refinement activity.

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A Digital Ecosystem for Extended Logistics Enterprises

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Abstract: The connectivity and information richness arising from the advent of the web has contributed to an increasingly dynamic business environment and marketplace, forcing a change in traditional business thinking from a static, closed and competitive business model to open, flexible and collaborative conceptualisation. It is this radical shift in business thinking and implementation that has created a need for new business paradigms and new organisational forms. This chapter presents a new business paradigm known as Digital Ecosystems, its concept, underling issues and its application to Extended Logistics Enterprises. We provide a novel Digital Ecosystem approach to the logistics industry and create a digital service framework which will foster logistics partnerships and collaborative supply-chains.

Keywords: Digital Ecosystems, Loosely coupled, demand driven, proactive, responsive, interaction and balance, Digital Logistics Service Ecosystems

Introduction

The advent of the web and its intrusion into business, commerce, government and health have provided mechanisms for binding organizations together, for carrying out activities over great distances and at any time. This has created new modes for marketing and enabled partnerships previously inconceivable within a wide array of business as well as other human activities. A consequence of this connectivity and information richness is that we are now faced with an increasingly competitive and rapidly evolving environment. We now require new business paradigms and organization forms that transcend the previous static, closed models and move to open, flexible, and collaborative models that are able to respond to the environment dynamics inherent within the networked economy. This new model and business paradigm is defined as a Digital Ecosystem.

1. Digital Ecosystems

In an ecological system environment (Figure 1), we consider species in analogy with biological species, create and conserve resources that humans find valuable. The Software, Databases, Applications, or Software Services in Digital Ecosystems are referred to as *digital species*.



Figure 1: The Analogy with Ecosystems

Economic species in analogy with Biological species, such as business entities, together form a dynamic and interrelated complex ecosystem (Figure 2). The *Complex ecosystem* is defined as a composition of mixed multiform heterogeneous entities participation in domain and cross domains interaction and engagement. A *Domain* is defined as a specific field or environment where participants have something in common or share the same interests, such as Corel Reef Ecosystem in the biological sphere (Figure 1), Rain forest Ecosystem, etc. *Cross Domain* is defined as inter-Domain interaction, such as a Corel Reef Ecosystem interacting with the Human Domain or Ocean Ecosystems.

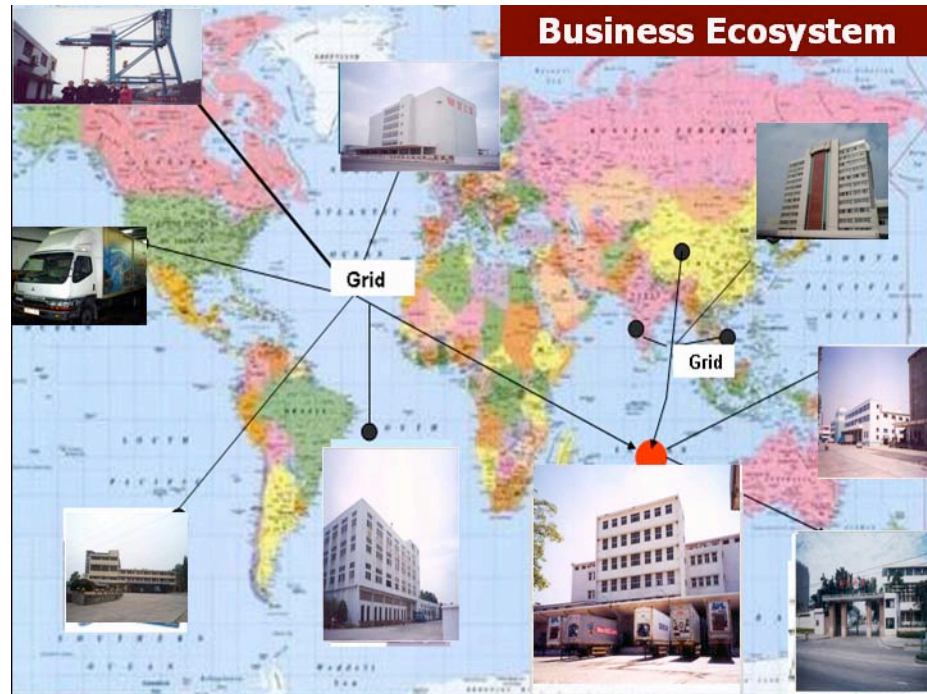


Figure 2. Business Ecosystem

Therefore, we define a **Digital Ecosystem** as a loosely coupled, demand driven collaborative environment where each digital species is proactive and responsive for its own benefit or profit.

We define *loosely coupled* as a freely bound open relationship between participants or entities within a virtual community. This term is opposite to the tightly coupled relationship, where each party is heavily dependent on one another and the roles are pre-defined. Participant is defined as an entity who wants to join a group or an environment or a community based on its own interest.

Demand Driven is defined as the driving force coming from outside 'push-in' rather than 'pull-in'. For example, the current networked economy has led to supply chains to demand chain, where demand is volatile and supply is uncertain. Another negative example is that the current collaborative environment is not a demand driven environment, because humans are told to collaborate, and humans may be forced to collaborate. This is not a demand driven, and human is forced to be there for the sake of collaboration rather than enjoying collaboration arising from a perceived mutual interest of the parties collaborating. There is no real honest consideration about whether there will be a benefit or a profit from the collaboration to the collaborating parties.

Collaborative environment is defined as an environment which contains human individuals, information technologies that human can capitalise, tools that facilitate interaction and knowledge sharing, and resources that help maintain synergy among human beings or software agent.

Human Agents and Software Agents in a digital ecosystem are referred to as Eco-agents. *Eco-agents* are capable of acting autonomously often capable of decision making and responses with in the context of a digital ecosystem.

Proactive is defined as an agent or eco-agent who is full of enthusiasm to participate in team work or community work.

Responsive signifies an agent or eco-agent who demonstrates willingness, is passionate about the issues, is cooperative and takes responsibility for its action.

Benefit refers to an advantage that an agent can take without any risks.

Profit refers to personal financial gain.

Digital ecosystems transcend the traditional rigorously defined collaborative environments, such as centralised (client-server, where each node in the collaboration network is predefined as either the client or the server, and they highly dependent on each other to perform the function) or distributed (such as peer-to-peer, where each peer is predefined as either a peer or a server, and communicates only via client to client or server to server) models. Digital Ecosystems, in contrast, are agent-based (human or intelligent digital species), loosely-coupled (the participants are free to join the virtual community), domain-specific (the participant have similar backgrounds) and demand-driven (they choose that they want to join the collaboration and determine their own requirements and expectations of the system) interactive communities which offer cost-effective digital services and value-creating activities (every agent or digital species is doing positive things for the community) that attract agents to participate (it is this freedom and open environment that is attractive) and benefit from it.

A *Digital ecosystem* is a self-organizing digital infrastructure aimed at creating a digital environment for networked organizations (or agents) that support cooperation, knowledge sharing, and development of open and adaptive technologies and evolutionary domain knowledge rich environments. It is a business model innovation in the Digital Economy.

2. Characteristics of Digital Ecosystem

Several factors characterise “Digital Ecosystems” namely:

- It has a strong information infrastructure that extends beyond the original closed walls of the individual organization.
- It is a domain-oriented *Cluster*, which forms an interactive community that has attracts to it similar species which challenge and support each other to survive.
- It contains rich resources that can offer cost-effective digital services and value-creating activities for the participants.
- It utilises new forms of electronic interaction, provision of digital services and use of services.

- It carries high connectivity and electronic handling of information of all sorts including data and documents.
- It offers multiple channels for buying and selling of services.
- It captures and utilises business intelligence from data, document and other agents and has *smart information use*.
- It is an integration of business, human endeavours and advanced information systems within the digital ecosystems.
- It facilitates close interaction between participants and cross fertilisation and nourishes each other and supports different needs within the digital ecosystem and between different digital ecosystems.
- It is a cross-disciplinary interaction and engagement, which offers a mix of expertise that preserve and enhance productivity, prosperity and international competitiveness.
- There is always an underlying knowledge base available to support information communication that enables shared understanding of concepts.
- Information is highly distributed, heterogeneous and massive, like a huge library without a catalogue system.
- Ecosystem participants or agents are autonomous, highly interrelated and dynamic and able to coordinate among themselves.
- “A Digital ecosystem is a self-organising digital infrastructure aimed at creating a digital environment for networked organisations (or agents) that support cooperation, knowledge sharing, and development of open and adaptive technologies” [40] and “evolutionary domain knowledge rich environments” [15].

The European Union defined Digital Ecosystem as a new initiative [40] and announced “Innovation Ecosystem Initiative” as part of the European Seventh Framework Proposal, and part of the i2010 initiative [38]. It is also noted that there will be a first inaugural IEEE International Conference on Digital ecosystems and Technology to be held in Cairns, Australia in Feb 2007 (www.IEEE-DEST.curtin.edu.au). This demonstrates the innovation and significance of the research at international level.

3. Digital Logistics Ecosystem

Transportation and warehousing logistics are activities that require strong information systems and communication infrastructure support. This requirement has grown with the advent of e-commerce. Companies such as FedEx and UPS now allow their customers to receive end-to-end service, track and trace and monitor the fulfilment, and quality evaluation of their requested services on the Internet.

Recent P2P e-commerce has resulted in an increasing tendency for virtual service providers to assemble several companies (or Partners) into strategic alliances that allow sharing of their physical facilities to achieve utilisation of logistic services beyond their own region of operation. For example, the pooling of warehousing and transportation facilities over a widely geographical distributed area of operation through an integrated

virtual logistics hub. This creates special needs for inter-organisational information exchange and data integration and an architecture to support a virtual logistics cluster.

Today, logistics enterprises are threatened by global enterprise services. Companies are facing a challenging missions every day to improve operational costs, increase productivity and customer service through optimising inter-company processes rather than just focusing on intra-company processes. Virtual Collaborative Consortia logistics are a prime example of Digital Ecosystem. Collaborative Supply Chains involve vertical industry collaboration and the *logistics network* involves horizontal industry collaboration. Logistics activity represents approximately 9% of Australia's GDP - or \$57 billion - and it has been found that the introduction of collaborative logistic systems can achieve a 500% return on investment (Talevski, A., Chang, E., Dillon, T.S. 2005). Weakness in logistic capabilities creates a multi-billion dollar cost burden on the Australian economy. Logistics and supply-chains are vital to the global economy, especially in developing countries where the 90% of logistics companies are SMEs.

In order to compete in a global market, it is thus vital for logistics enterprises to share logistics information for cooperation. A Digital Ecosystem can provide logistics consumers with transparent information about services within the ecosystem community that allow quality of service evaluation, service negotiation and quality-of-service guarantees. Current internet service requests, find and bind tools are inadequate for logistics and supply-chain consumers and providers, because the services available in the network are often limited, have poor semantics involved, short-cuts and are incomplete and there is no quality-of-service information available. Suppose a logistics customer needs to find out about a goods yard. A query to a web service registry or www.google.com for 'goods yard' lists 72,900 items. Moreover, there has not been a web service designed targeted specifically for the transport logistic industry today in the world.

A *Digital ecosystem* can be specifically developed for the Logistics Small Medium Enterprise community (Figure 3), where species in the ecosystem such as heterogeneous enterprise systems, business portals, service brokers and organizational databases occupy the Digital ecosystem. Digital ecosystem technologies provide transparent, micro, open ICT technologies that advance the ecosystem through its intelligence and knowledge based development to move away from isolated business to business competition to improve the collaboration, competition, quality and quantity and synergies between partners, enabling local value chains and enhancing their competitiveness over the global market. The proposed system generates a new solution for the extended logistics enterprises, especially e-logistics and e-warehousing environments which is essential for the extended enterprise and business intelligence. SMEs provide the engine for growth of value added products and services in the extended enterprise and logistics marketplace, and so can deliver substantial economic benefits to ICT and logistics industries, deployment of improved trade and export industry infrastructure – based on Digital Ecosystems solutions.

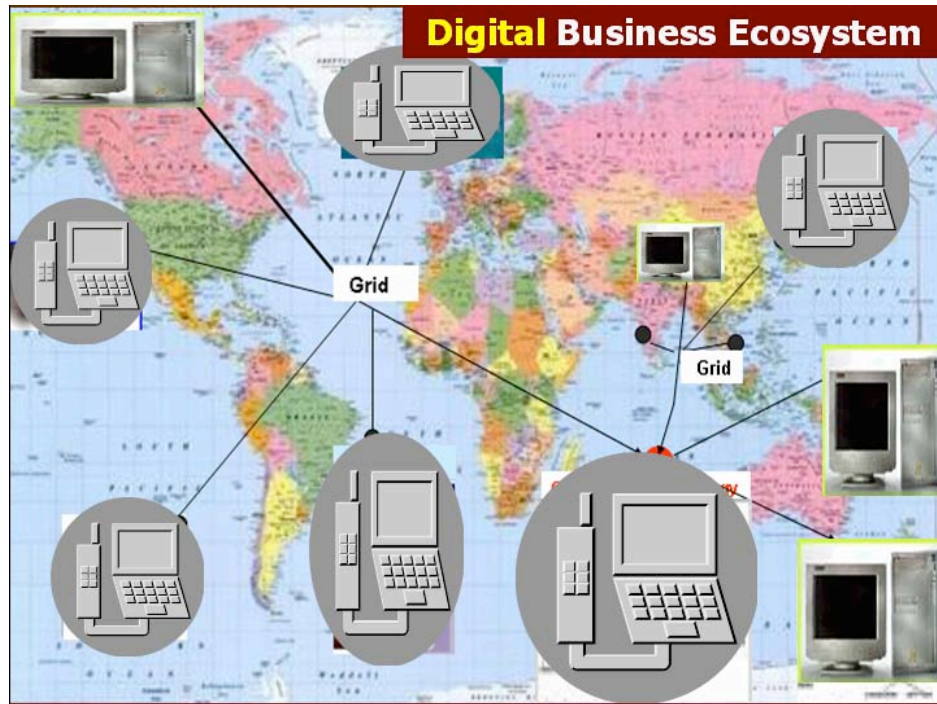


Figure 3: Digital Logistics Service Ecosystem

4. An Intelligent Digital Ecosystem for Extended Logistics Enterprise

An Intelligent Digital ecosystem (Intelligent DES) advances the ecosystem through its knowledge base development from Orchestration to Choreography. The key technologies underpinning this development are Ontology, Agent-based systems, automated digital service discovery. Eco-agents within the Digital ecosystem are a departure from the traditionally defined 'agent' in Multi-agent Systems where an agent only represents an application that operates in a system or a database, whereas Eco-agents represent the economic organisms or digital organisms which is a system that incorporates loosely coupled applications and their information resources or databases. Ontologies help to organize the logistics domain-specific knowledge that tells the on-line customer about the structure of the ecosystem and its Eco-agents' (species') functions, personality, who they are, what they do, and how they do. Onto-agents are Ontology-based intelligent leading software species have strong reasoning capabilities which can manage, coordinate and collaborate between ecosystem agents (Eco-agents). Therefore, we could represent:

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Digital ecosystem(DES)= Eco-environment + Eco-agents

Intelligent Digital Logistics Ecosystem = Onto-Eco-environment + Onto- Eco-agents

where Ontology-based Eco-environment for logistics is the Eco-system adopting an Ontology as it shared knowledge base. Ontology-based Eco-agents are Eco-agents which annotate themselves through the Ontology and the Onto-agents are special Eco-agents, designed for Ontology utilization and to manage Ontology-based Eco-agents' interaction and coordination.

The Intelligent Digital Logistics Ecosystems have the following significance:

- All SME partners (agents) should join the logistics network, as each acts as an intelligent agent, sharing expertise, resources and business. For example, if a SME provider is fully occupied with their business for one month, they should refer the extra business to the nearest partners, so that in return, he will be treated reciprocally in future.
- Each logistics Provider shall be an intelligent agent that is an autonomous entity which participates in the community on its own initiative.
- Small Medium Logistics Enterprises are heterogeneous; therefore, they only need to form loosely coupled relationships between other SMEs, rather than traditional environments where entities are carefully blended together with predefined roles to play.
- Ontology-based logistics back-end database services in the ecosystem share commonly agreed vocabulary and concepts and they communicate knowledge through the commonly shared Ontology.
- Each Logistics SME can be a client (when querying) or a server (when queried) in a collaborative environment, whereas in a traditional setting, a communication entity or object is either a client or a server or other roles that are predefined.
- Demand-driven participation shall be a primary characteristic of logistics SMEs (Eco-agents) and they understand that they collaborate in the ecosystem is for their own benefit or profit. They remedy problems through collaborative effort, sub-tasking, coordinated actions, shared intelligence and skills. Unlike the traditional collaborative environment (such as client-server), it is a controlled environment, where entities or objects may not have direct benefit or profit from the collaboration.
- Human Experts are able to design and access intelligent logistics agent systems so that they can work together and coordinate with each other.
- Intelligent Logistics SMEs are proactive, adaptive and responsive eco-agents within an ecosystem thus provide the ecosystem with dynamism, efficiency and stability.

Conclusion

In this chapter, we have given a conceptualisation of Digital Ecosystems, its characteristics and its application to the Digital Logistics Ecosystem. A Digital ecosystem is able to employ the relationships and interactions between human, digital species, and infrastructure within the digital ecosystem. Finally, the chapter proposes an Intelligent Digital Ecosystem for Small Medium Logistics Enterprises.

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Collaboration Technologies and Practices: A Canadian Perspective

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Abstract: The adoption of collaboration technologies in organizations has attracted much attention through the years. With the emergence of location technologies new opportunities for context-specific collaboration arise. This chapter presents the results of a survey on collaboration technologies and practices. It takes a broad view of collaboration including potential positioning technologies and practices and includes the evaluation of potential benefits to organizations. The survey targeted the top 1000 publicly traded Canadian businesses as ranked by assets. The preferred technologies are traditional commercial collaboration applications oriented towards management. Despite the current enthusiasm around location technologies, positioning systems are not common in organizations. However, the interest for RFID technologies may change this picture.

Keywords: collaboration, CSCW, positioning technologies, survey, top 1000 Canadian businesses

Introduction

The sustained effort for universal and ubiquitous connectivity, embodied by recent initiatives for panurban wireless networks and the ongoing development of feature-rich mobile devices, has brought a new meaning to the concept of “anytime, anywhere”. It has expanded the horizon of virtual communities to integrate real-time mobile multimedia communication, location-based services and context-aware peer interaction.

Today, the commoditization of location aware devices (GPS, cellular phones, on-board navigation systems, etc.) and the advances in indoor positioning systems (IPS) based on RF technologies (RFID, RTLS) have the potential to greatly enhance our experiences of mobile work and context rich collaboration at the individual, group and organizational levels. On the more traditional corporate front, however, the collaboration landscape presents mixed stories of bright success and bitter failure. For this reason, the adoption of collaboration technologies in organizations has attracted much attention throughout the years both in

computer science [1,2] and in information systems [3,4]. It still remains a constant preoccupation.

The adoption and spread of collaboration technologies in an organization depends ultimately on the users [5]. Whether it is the perception of usefulness and the ease of use of the technology [3] or the general adoption by members [1], the users must be involved in the process of technological evolution. In many cases however the realm of strategic planning of technologies and processes alike remains in the hands managers and executives. Their influence is decisive in searching for and acquiring technologies. Their role is also essential in lowering administrative hurdles and fully supporting such projects [6]. In an attempt to portray the current state of collaboration on the Canadian scene from the point of view of strategic planners, this chapter presents the results of a survey on collaboration technologies and practices for the leading top 1000 Canadian businesses.

1. Collaboration, Mobility, and Business

From the call for research on mobile collaboration of Luff and Heath [7] to the vision of the context-aware collaboration space by Mark [8], the importance of mobility and location-based systems in computer supported collaborative work has grown in recent years. PDAs, cellular phones, laptops and Blackberries are now part of the standard equipment of many businesses and have contributed to change the context of collaboration [9,10]. New location-based services (LBS) and emerging positioning technologies such as RFID are providing further research opportunities driven by emerging fields like microgeomatics [11].

Though mobile and location-aware collaboration lends itself to the imagination of great scenarios [12], the problem of adoption of collaboration technologies in organizations remains. This topic has fueled many general and specific research initiatives. In the field of information systems, the Technology Acceptance Model (TAM) [3] has provided key insights to adoption factors for information technology in general. Closer to the collaboration field, Soroka and Jacovi [13] designed a framework for successful diffusion of collaboration technologies. To our knowledge however, no macro-level investigation targeted the potential contribution of mobility and location systems to collaboration. Because persistent and spatially ubiquitous information can bring new concerns for collaborative work [14], it is important to draw a current view of the situation.

2. Research Objectives

Our research aim was twofold. First, we sought to evaluate the current and potential use of collaboration technologies and practices in major Canadian businesses and link this usage to the benefits conferred by these technologies. Second, we expected this research to lead to important insights for future developments and uses of collaboration technologies in the light of new mobility and location opportunities such as positioning systems (GPS, RFID, RTLS, etc.).

3. Methods

A review of the collaborative work literature was undertaken to identify current or emerging technologies and practices supporting collaborative work. This effort was supported by the identification of a series of workplace variables and factors linked to collaboration and the potential effects in organizations. Five broad categories were identified and served as a basis for the elaboration of a questionnaire:

- Electronic data/information/knowledge management
- Collaborative practices/communication/coordination
- Mobile work/devices/infrastructure
- Location technologies/practices
- Business processes

A questionnaire was designed to measure the prevalence of collaboration technologies, collaborative practices, and their expected effects on different organizational variables. The questionnaire span four pages and presented 11 questions and 58 sub-questions. It included questions on the profile of the respondent and its organization, the prevalence of collaboration technologies and practices, and the expected effect of collaboration technologies and practices. No personal information was requested; thus, completed questionnaires could not be linked to an individual.

The questionnaire was distributed through a mail survey targeting senior executives managers of Information Technology (IT) departments of the top 1000 publicly traded companies in 2004 as measured by assets according to Globe Investors [15]. The survey was composed of a personalized letter to the president or chief executive officer (CEO) explaining the research goal and requesting the help of their senior IT manager, a letter to the senior IT manager presenting the questionnaire, and the questionnaire itself. Surveys were sent directly to presidents and CEOs for organizations having a valid Canadian address. Organizations with addresses outside Canada or with unknown president/CEOs were not contacted.

Between May 30 and June 3 2005, 867 businesses were successfully contacted. A personalized reminder letter was sent three weeks later to increase response rate [16]. Responses were accepted until mid August 2005. The survey was made available in English to all businesses except those in the province of Quebec that received a French version. In our presentation letter to the senior IT managers, we explicitly stated that the survey was also available in the other Canadian official language, but received no request to this effect.

Data were compiled and analyzed. Standard descriptive univariate and bivariate analysis and plotting methods were applied to the data to compare results between sub-questions.

4. Results

a. Response rate

Among the 867 businesses contacted, 72 returned a completed questionnaire. This corresponds to a response rate of 8.3%. Given the exploratory nature of the research, this response rate is considered acceptable [17] and is consistent with similar researches in the literature, e.g. [4].

b. Profile of the Respondents

The original target sample was mostly composed of companies from Ontario (43.6%), Alberta (23.0%), Quebec (14.3%), and British Columbia (11.7%). Other provinces accounted for a total of 4.1% and 3.2% of the Canadian top 1000 were found overseas (UK and USA). The anonymous nature of the survey did not provide information about the origin of the respondents.

The size of the organizations in terms of total number of employees is show in Table 1. The distribution shows presence in all categories with an increased representation of larger organizations. This asymmetry was expected from the 1000 largest Canadian businesses.

Table 1. Size of organizations of sample.

Total employees	Number of organizations	Percent
1-99	10	14.1
100-499	11	15.5
500-999	13	18.3
1000-4999	22	31.0
5000 and above	15	21.1

Table 2 shows the distribution of the respondents according to their general sector of activity. We can observe a fairly even distribution between all sectors. The detailed picture shows the prevalence of Manufacturing (27.8%), Mining, Oil or Gas (26.3%), Finance and Insurance (9.7%) and Other Services (8.3%). All other sectors were below the 5.0% mark.

The perceived importance of new information technologies in organizations was requested to evaluate the potential effort invested in technological business intelligence and the appreciation for emerging technologies. Results appear in Table 3. The largest category was composed of moderately (43.0%) interested organizations almost at par with highly and very highly interested ones (47.3%). The very low score of the “Little” category is not surprising, as most uninterested organizations probably did not respond at all.

Table 2. Organization sector of activity of sample.

Sector of activity	Number of organizations	Percent
Primary	21	29.2
Secondary	21	29.2
Tertiary	24	33.3
N/A	6	8.3

Table 3. Importance of new information technology (IT) for organizations

Importance of new IT	Number of organizations	Percent
Little	4	5.6
Moderate	31	43.0
High	22	30.6
Very high	12	16.7
N/A	3	4.1

c. Collaboration Technology

Fifteen sub-questions covered the use of technologies in the organizations. Data, information and knowledge management systems, communication and coordination systems, mobility, location and remote access systems were the three categories investigated. Respondents were asked to evaluate on a numeric scale the use of different technologies from “Not Used” (0) to “Prevalent” (10). Alternatively, respondents could indicate a future implementation (within two years) of the technology or that it was unknown to them. Sub-questions were formulated by a single phrase (e.g. Portable computers) and examples were provided (e.g. Pocket PC, PDA, Blackberry) where generic terminology might have been ambiguous.

Figure 1 shows the compiled results from the technology use question. Shared electronic calendaring ((G) mean 7.89, median 9), Remote access to the company information ((M) mean 7.78, median 9), and to a lesser extent Office access control system ((O) mean 6.65, median 9) ranked as the three most widely used technologies identified by the respondents. All technologies associated with positioning (GIS (J), GPS (K), and RFID (L)) ranked lowest (mean 2.32, 2.12, 1.08 and median 0, 0, 0 respectively) despite the current enthusiasm around mobile and location technologies. Interestingly, the RFID location technology also ranked highest (8.3%) in the technology to be implanted within the next 2 years notwithstanding the 7.0% of the respondents indicating that the technology was unknown to them. The traditional commercial collaboration software ((D) e.g. Lotus Notes) obtained a mean of 5.92 and a median of 7, electronic forums and mailing list (F) obtained a mean value of 6.03 and a median of 7 while instant messaging (E) ranked very low at a mean of 2.88 and median of 1.

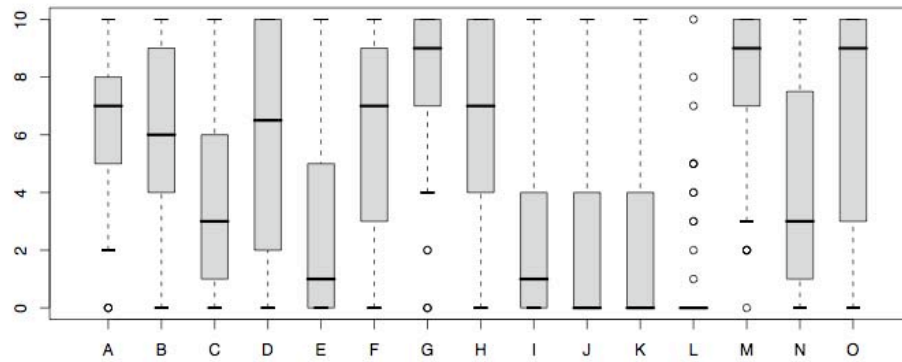


Figure 1. Technology use in organizations, where A) electronic asset management software, B) data warehouse, C) knowledge management system, D) commercial collaboration software, E) instant messaging, F) forums and mailing list, G) shared calendaring, H) portable computers, I) whiteboards, J) geographic information system, K) global positioning system, L) radio frequency identification, M) remote access to organization network, N) wireless network, O) office access control system

Data were further analyzed using the crosstab method and a Chi-square test under the SPSS 11.0 statistical software. Numerical results were reclassified into “High” and “Low” usage categories. In order to satisfy the minimum data requirement of the cosstab method, other variables were also reclassified. The sector of activity (primary, secondary, tertiary) and the size of the organization (less than 1000, 1000 to 4999, 5000 and above) were used for the analyses. Positive correlations were found between primary sector organizations and geographic information system ($\alpha < 0.05$) and Global Positioning Systems ($\alpha < 0.1$) despite their low original score. The size of an organization was found to have a low impact on the use of technologies, although previous evidence from [4] supported the opposite. The broad focus of the survey might explain this difference.

d. Collaborative Practices and Businesses

The fifteen sub-questions on the prevalence of collaborative practices in organizations presented the same structure and scale as the sub-questions on technology usage. Questions can be divided in five general categories: project management, communication practices (e.g. community of practice), location analysis (e.g. vehicles), personalization of the information, and technology assessment. Figure 2 presents an overview of the results for these fifteen sub-questions.

The practices in collaboration that were ranked most prevalent are: the use of personal electronic management of projects such as MS Project ((A) mean 5.93, median 7), telework or mobile work ((D) mean 6.10, median 7) and the consideration of technological issues during the business process definition or analysis ((O) mean 6.23, median 7). Real-time location of employees or equipments ((K) mean 1.88, median 0) and of vehicles ((L) mean 1.81, median 0) ranked lowest. The location of clients, competitors or suppliers (J) did much better with a mean of 4.82 (median 5). It is also important to note the very high proportion of respondents (27 in number, 37.5%) that indicated that they did not know about communities of practice (E).

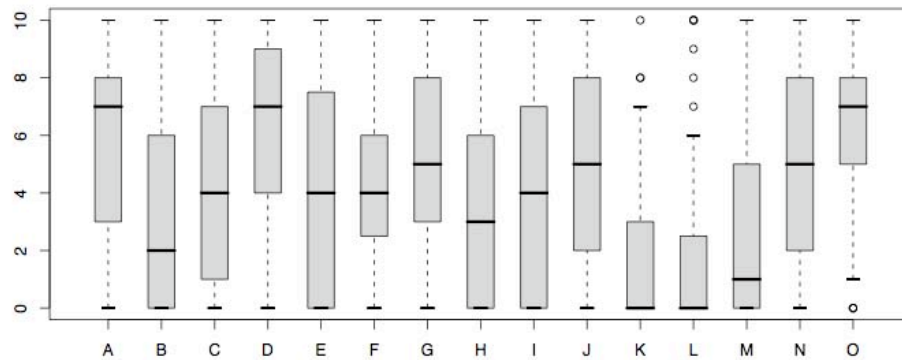


Figure 2. Practices prevalence in organizations, where A) personal project management, B) organizational project management, C) Web conferencing, D) telework/mobile work, E) community of practice, F) remote training/knowledge transfer programs, G) version management of information/documents, H) real-time notification of information updating, I) simultaneous work on shared project in distant offices, J) location of clients/competitors/suppliers, K) real-time location of employees/equipments, L) real-time location of vehicles, M) personalization intranet/portal, N) multi-device access to same information, O) consideration of technological issues during business processes definition and analysis.

Bivariate analyses were carried using the same methods and variable classes as in the previous section on technologies. In this case the size of the organization seemed to have a prevalent impact on the presence of practices in an organization. Both the community of practice (E) and the consideration of technological issues during business process definition or analysis (O) variables were found to be positively correlated ($\alpha < 0.05$) with businesses counting more than 5000 employees. The analysis on the sector of activity variable did bring new insights.

e. Expected Effects of Collaboration

Respondents were asked to evaluate the expected effect of using collaboration technologies in their organization given 12 specific parameters. Their appreciation was recorded for each parameter on a scale from “Considerable deterioration” (0) to “Considerable improvement” (10), where 5 corresponded to a neutral effect (no effect). Table 4 presents the parameters with their respective scores.

Variables	Mean	Median
Employee satisfaction	6.90	7
Employee productivity	7.12	7
Cohesion of work teams	7.06	7
Interaction between distant working teams	7.44	8
Absenteeism from work	5.32	5
Information access	7.91	8
Information quantity	7.59	7
Capacity for the company to adapt to its environment	6.78	7
Control of operational costs and traveling expenses	6.19	6
Planning and allocation of resources	6.38	6
Organizational planning	6.35	6
Efficiency of decision processes	6.96	7

Table 4. Expected effect of using collaboration technologies of selected organizational variables, where 0 is a considerable deterioration, 5 is a neutral effect, and 10 is a considerable improvement.

Although, “Interaction between distant working teams” and “Information access” ranked highest, no parameter really stood out. Collaboration technologies were regarded as having no effect on absenteeism (60.6% ranked it as neutral). With the exception of the latter dimension, the appreciation of collaboration technologies by the respondents showed a positive, generally undifferentiated, bias towards this kind of technologies.

As in the previous cases, bivariate analyses were carried on this portion of the data. No evident relationships were found.

f. Factors Influencing Information Circulation

In the last block of sub-questions, respondents were invited to indicate the consequence of 13 factors on information circulation in their organization. Again, a scale from “Considerable deterioration” (0) to “Considerable improvement” (10), where 5 corresponded to a neutral effect (no effect). Table 5 presents the factors and their respective scores. Scores were particularly uniform and no factor was singled out.

The standard crosstab and Chi-square bivariate analyses were applied the evaluation of the factors influencing to information circulation. Interestingly, the analysis pointed out a significant negative relationship ($\alpha < 0.05$) between the size of the organizations (less than 1000) and the prescribed use of specific commercial collaboration software, i.e. small business find less benefit in the use of commercial collaboration software for information circulation.

Factors	Mean	Median
Information growth	6.22	6.5
Management policies regarding the update of the company information	6.54	6
Centralization of information systems or standardization of technologies	7.2	7
Provision of the existing information to the employees	7.22	7
Regular training on the information systems	6.75	7
Continual evolution of technologies	7.04	7
Limiting the number of file format	5.96	6
Technological decision are rooted in business processes	6.93	7
Use of telework	6.08	6
Modularity of information systems	6.02	6
Prescribed use of a specific commercial collaboration software	7.03	7
Diversification of communication channels available to employees (e.g. PDA, instant messaging)	6.71	7
Availability of a general purpose search engine for information access	6.38	6

Table 5. Expected effect of selected factors on information circulation, where 0 is a considerable deterioration, 5 is a neutral effect, and 10 is a considerable improvement.

Conclusions

Building an accurate view of the state of collaboration in different organizations is a difficult matter. Many actors with different roles are involved in collaboration and the domain shows an extraordinary diversity. Yet, such a global picture provides a necessary ground for a reflection on past initiatives and potential lines of research and development rooted in real knowledge rather than intuition. Table 6 presents a summary of the main findings of the research.

It is not surprising to find traditional collaboration systems and information management systems leading the way in terms of technology use. Shared calendaring, commercial collaboration software a la Lotus Notes, forum and mailing lists, and assets

management systems have existed for a long time and shown their usefulness in many cases. Moreover, these technologies have been viewed to benefit management [1]. The prevalence of portable computers and remote access to the organization network indicate promising ground for future research and development in mobile work. Yet, positioning systems, with the exception of office access control systems traditionally used for security, lag behind indicating perhaps that context aware computing is still a long way from mainstream technology. The apparent interest in RFID technologies might change this situation and should be followed with interest. The introduction of this technology in traditional core business areas such as supply chain management (SCM) or customer relationship management (CRM) [11] could ease its adoption for alternative use such as location-aware or context-aware collaboration systems by reducing the cost of the location-aware collaboration systems and limit the need for technology promotion in the organization [13, 4]. This could support initiatives on spatially defined persistent information and localized collaboration similar to the GeoNotes [18] and Active Campus [19] projects.

Observation	Description
Collaboration technologies	Traditional management oriented technologies were most popular
Location oriented technology/practices	Very low usage primarily in the primary sector
RFID systems	May see a rapid adoption in the next few years
Perceived usefulness of collaboration systems	Undifferentiated marginally positive; does not provide leverage for new technology creation or adoption

Table 6. Summary of findings

As in every survey studies, our research faces limitations. First, we must acknowledge the optimistic nature of the results. Indeed, the data presented originates from the group of businesses most interested in the survey subject matter of collaboration software. Businesses with marginal or no interest in new information technologies probably did not take the time to answer. Though our picture may be biased, results may be used to characterize the “early adopters” or “technology positivists”. These organizations are prime targets for field experiments and prototype testing.

Second, technology managers are not the users and their capacity to evaluate organizational benefits might have been limited. High-ranking practices can generally be linked to technological or managerial concerns, e.g. project management, telework/ mobile work, linking technological issues and business process analysis. Moreover, specific collaborative practices such as communities of practice may mostly involve people from outside of the IT department. The richness of collaboration studies and practices involving people from different sectors of an organization is also a difficulty in trying to capture a

global view. An alternative approach for prospective studies could be to survey people from different organizational departments of the same organizations with the same questions and compare results.

Third, a generally positive low-contrast ranking of the effects of collaboration technologies on different business variables leave us with little leverage power for specific development of original systems. The absence of negative impacts of collaboration technologies, it is not enough for the technology to take its place in the organization or even capture initial interest. This observation leads to a number of questions: is location technology not mature/known enough to create interest, are collaboration technologies well understood in the IT departments of organizations, are the needs for collaboration adequately defined in organizations, are the proposed technologies answering these needs, and are the links between the benefits and the technologies strong enough to be noticed or evaluated. Each of these questions leaves us seeking a better understanding of collaboration in organization both at the macro and micro level.

It would certainly be of value to carry a follow up study in a few years to monitor the evolution of the situation. It would provide a dynamic picture that could bring new insights on the global collaboration picture. If location technologies find the adoption some specialists predict, it would be of particular interest to see the evolution of the gap between the concept of mobility and location. Future works on the issue would probably benefit from focusing on the question integrating the concepts of space (e.g. moving around) and place (e.g. been somewhere meaningful) as articulated by Harisson [20].

Future work

This survey did not provide sufficient information to build a typology of collaboration profiles of organizations. Further investigations should help to gain a better understanding of spatial information business users and the potential for collaborative work in this specific context. We plan to monitor the emergence of RFID technologies in organizations and work with businesses in developing context-aware collaboration systems based on people and equipment positioning. The first step will be to identify organizational needs and wants in term of location-based collaboration. This would entails more hands on research with specific organization. We have already found some promising grounds in health care management and public services.

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Collaborative Commerce: Next-Level Virtual Interorganizational B2B Relationships

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Abstract: This conceptual chapter sets the framework for understanding the underpinnings of collaborative commerce (c-commerce). Increasing pressure to meet customized requirements of buyers, shrinking product life cycles, rising obsolescence of high technology products, and diminishing profit margins are pushing firms towards a collaborative mode of working. Theoretical explanations in the management field are also sought in accounting for the more recent organizational forms used to support collaborative commerce. A short case study on www.e2open.com is used to illustrate how this initiative is implemented. On the information technology side, levels of c-commerce are defined and the tools for implementing this initiative are described. Finally, new technological bases for “trust” are presented to support the interimistic relationships spawned by c-commerce.

Keywords: Collaborative commerce, e-business, supply chain management, electronic trading partnerships

Introduction

The next level of evolution of e-commerce refers to collaborative commerce. This movement towards collaborative commerce interactions involves numerous firms acting as electronic trading partners implementing complex integration projects ([1], [2],[3]). Major drivers such as the increasing pressure to meet customized requirements of buyers, shrinking product life cycles, ever increasing obsolescence of high technology products, and thin profit margins such as in the case of the semiconductor industry are pushing firms to move towards a collaborative mode of working both at the interorganizational and business ecosystem levels. What are slowly emerging are recombinant clusters of systems supporting collaboration and cyber trading communities. Figure 1 shows what the new electronic based constellation of partnerships might look like via collaborative commerce (c-commerce).

The subsequent need to share intellectual capital has significant implications on trading partner management and coordination under the leadership of the host firm, also referred to as “hub firm,” “channel master,” “nucleus firm,” or “context provider.” C-commerce will sit atop an Internet-enabled application architecture that will stabilize as c-commerce communications standards evolve. This will significantly impact interenterprise decision

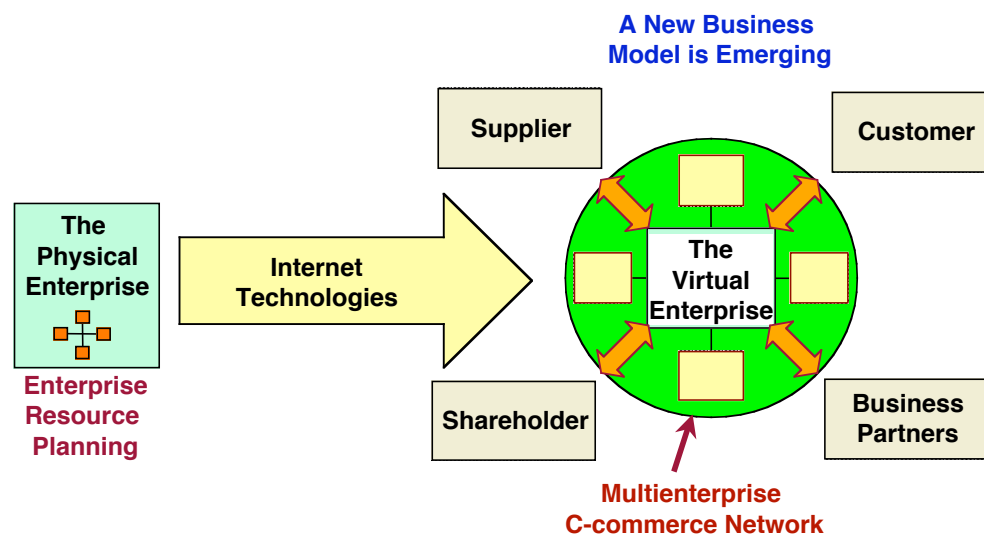


Figure 1. The Internet Enables Collaboration, But the Price Is Added Project Complexity [3].

making among participants in the value chain as tighter interdependencies are introduced involving a more complex cluster of activities.

This chapter has a number of objectives. First, it seeks to describe and clarify this recent initiative and to articulate its repercussions on electronic trading partnership management. Second, it seeks to situate the concept of “collaborative commerce” using theoretical frameworks to explain the organizational designs or forms used to link numerous electronic trading partners under altered, dynamic market conditions. Third, the information technology infrastructure required to support collaborative commerce is also described. Fourth, this chapter also seeks to redefine the concept of “trust” using governance mechanisms that are more appropriate to “interimistic” relationships exchanges that tend to characterize the newer forms of c-commerce partnerships.

“Collaborative commerce” has emerged as early as 2000 and this has allowed the “host firm” to go beyond the boundaries of rigid supply chain models in forging dynamic collaboration with its business partners---customers, suppliers, employees, and other

strategic partners in a trading community, which could be an industry, industry segment, supply chain, or supply chain segment ([4],[5]) through the use of Internet-enabled technologies. What needs clarification at the outset is what is really “new” about c-commerce. Management information systems (MIS) literature has covered the topic of “interorganizational systems” (IOSs) among electronic trading partners for quite some time now as various technologies have evolved to support such systems, and an important presumption of these systems is the willingness and ability of participating firms to collaborate with each other. Gartner Group presents the notion that c-commerce involved firms participating in a value chain that covered an entire industry, a segment of that industry, a specific supply chain, or a supply chain segment [6]. In the past, firms have been undertaking parts of the tasks involved in a closed loop end-to-end supply chain. Now that Internet-enabled technologies are available, it is possible to not only accomplish tasks before, during, and after the sales transaction, but also, it is possible to involve and connect electronic trading partners of all firm sizes within one’s value chain [7].

Therefore, c-commerce reaches far beyond the traditional limits of the firm’s electronic network to include potential trading partners in the “cybermarket.” What distinguishes c-commerce, in effect, is its drive to support mutually beneficial problem solving and exploitation of market opportunities with firms beyond one’s traditional cluster of contacts, often leading to the restructuring of these firms’ relationships [8]. Also, business issues involved are more complex and need human oversight such as would be required in product design---thus communications would involve unstructured data and intensive human interaction. Earlier interenterprise implementations such as those supported by electronic data interchange or EDI have emphasized exchange of business transactions and business process workflow data, both of which are more structured in nature and were facilitated by machine-to-machine data transfers with little or no human intervention. C-commerce participants will use a wide range of communications modalities involving both structured and unstructured content, with the shifting emphasis toward support for human interaction.

C-commerce is said to have arisen out of enterprise resource planning (ERP) applications, which were originally internally focused but were eventually reoriented to allow external connectivity with the core firm’s suppliers, customers, and other strategic partners [9]. Thus, the reference to ERP II has led practitioners to refer to open, permeable intercompany systems that tend to be focused in specific industries. Also, c-commerce embraces the following technologies and business practices: EDI or an equivalent extensible markup language or XML-derived syntax; enterprise integration; product data interchange; outsourcing via e-marketplaces; virtual product development/distribution; and virtual enterprise operations [10].

1. Adaptive Organizational Forms and Designs

This section intends to look at the forces in the marketplace that have driven the creation of new adaptive organizational forms and designs to meet the needs of higher-level forms of IOSs now supporting c-commerce.

The competitive marketplace has been radically transformed by the forces of technological revolution and increasing globalization [11]. To ensure survivability under these conditions, firms need to arrange their dynamic core competencies and human capital and manufacturing technologies in a way that assures strategic flexibility. One adaptive response to this global marketplace challenge is to use more modular forms of organization [12].

Management academics and researchers have noted that in the past two decades, there have been dramatic changes in the nature of the firm. “Virtual organizations,” or “network organizations,” or “modular organizations” characterized by loose interconnected interorganizational components with semipermeable boundaries have replaced monolithic hierarchical entities ([13],[14],[15],[16]). The boundaries of a single firm no longer house all critical production activities, which, occur, nowadays, in the nexus of relationships between or among a number of firms that have agreed to contribute to the production function [17]. These new organizational designs or forms allow participants to achieve scope and scale efficiencies---the very drivers that made them join together in networks ([18],[19],[20],[15]). Achrol [22] vividly portrays this significant organizational shift:

Large-scale downsizing, vertical disaggregation and outsourcing, and elimination of layers of management have gutted the mighty multidivisional organizations of the 20th century. Replacing them are leaner, more flexible firms focused on a core technology and process, laced in a network of strategic alliances and partnerships with suppliers, distributors, and competitors.

An important advantage of the modular organization is that organizational components can be easily recombined into a wide variety of configurations to meet the latest market demand or idiosyncratic customer preferences [17]. This flexibility becomes increasingly valuable as more and more heterogeneous demands are placed upon the firm---a key characteristic of this age of mass customization.

Being able to recombine organizational components in multiple configurations enables a firm to more closely meet heterogeneous demands with less investment than if components were not recombinable: recombining achieves “economies of substitution.” [22].

One specific way of recombining firm capabilities is through outside contracting. Rather than build certain manufacturing capabilities in house, a firm can choose to use an outside contract manufacturer for making certain products. In fact, the firm can switch among different contract manufacturers that each specialize in very specific production modalities. The manufacturer experiences the same kind of flexibility in that it could work for different customer firms. As firms within an industry increasingly use organizational components outside its boundaries, the entire production system becomes modular and the firms participating as a network of collaborating production units become “more

specialized components” themselves [17]. Other ways of substituting loose couplings for activities that used to be conducted in house would be to engage in alliances or to use alternative work arrangements (i.e., use of temporary workers on a project basis) ([23],[11],[16]).

Firms in the semiconductor, computer, and apparel industries provide numerous examples of cutting-edge “modular” firms such as Microsoft, Dell Computers, Cisco, and Reebok, all of whom have been able to recombine organizational components through outsourcing and strategic alliances [24]. Paying particular attention to Dell Computers, we find that this firm participates in an industry where the range of potential inputs and customers are rapidly changing, wide, and diverse. Dell has been known to outsource nearly all of its design and innovation components, software, and nonassembly production. Dell has functioned as the master choreographer dexterously directing and coordinating the output of a wide range of information technology specialists to produce an array of cutting-edge products satisfying an increasingly demanding and unforgiving clientele---in a manner still capable of minimizing the risks to Dell itself [25]. Using a network of loosely coupled working arrangements with numerous outside manufacturing contractors, Dell has even been able to very rapidly change the nature of still relatively new product lines, for instance, by incorporating even more recent technological advances, to satisfy mercurial customer demands.

Another thinker who envisioned the same kind of collaborative amalgamation of organizations is James Moore [26], who coined the phrase “business ecosystem,” which is “...an economic community supported by a foundation of interacting organizations and individuals---the organisms of the business world....” To Moore, the business ecosystem includes customers, suppliers, lead producers, even competitors, and other stakeholders, who act together under the direction of a “context provider” [27]. This firm is also equivalently referred to as the “hub firm” or “nucleus firm”.

2. C-Commerce Manufacturing Initiatives

The following are more specific initiatives involving c-commerce at various stages of the manufacturing cycle [28].

2.1. Collaborative Product Design

Customers are getting more demanding and particular about their requirements. Manufacturers need to gear up for a more active and direct participation of customer end users. Customer-driven configuration and specifications rather than R&D plans, prototypes, or forecasts will drive the manufacturing process. Product designers are increasingly receptive towards modularization, serviceability, and marketing requirements.

2.2. Collaborative Production

Outsourcing is the primary vehicle for helping manufacturers cope with escalating customer demands. Manufacturers will focus on their core competencies and outsource materials, parts, and operations outside their primary areas of expertise. The main challenge for the host manufacturer would be to find strategic partners that can allow it to decrease volume production time and to respond to changes in customer product specifications within shorter windows of time.

2.3. Collaborative Planning, Fulfillment, and Distribution

This concerns forecasting, generation, fulfillment, and delivery of orders. Collaborative planning, forecasting, and replenishment definitely include vendor-managed inventory programs if suppliers' forecasts are reliable. Accurate forecasts need to be generated early enough to allow better plan production and consequently, shorter product life cycles. Order and market information is allowed to flow upstream continuously from the point of sale and in the opposite direction, information on product availability and inventory levels is also made available. By allowing information to flow continuously in both directions, compounded information inaccuracies that occur when the different value chain nodes have widely varying interpretations of supply and demand are, hopefully, reduced. Ultimately, too, the goal is to eliminate inventory shortages and surpluses as better understanding of customer demand is captured and responded to.

Collaborative fulfillment involves the use of joint or negotiated decisions over order size, frequency of delivery, and the transfer of ownership and management of inventory from the customer to the supplier---leading to reduced incremental distortion of demand [29]. Using this approach, actual customer demand rather than dated forecast data is used to drive actual order fulfillment.

2.4. Collaborative Marketing

Firms will seek to involve customer input to avoid product rework and allow glimpses into early signs of product decline or increased product demand much sooner than usual. To accomplish this, firms need to link promotion results to forecasts which will, then, lead to product marketing innovations delivering more rapid brand "mind share." This, in turn, will enhance the firm's knowledge of packaging and product feature innovations that customers prefer, thereby, leading to enhanced product demand.

2.5. Collaborative Service

As firms roll out more products or product components, an equivalent increase in demand for customer product support and after-sales service ensues. Firms engaged in customer support via indirect channels or remote employees should use collaborative initiatives to better communicate with its customers in meeting after-the-sales service obligations.

3. Levels of C-Commerce and Technologies Used

Collaborative commerce integration could be depicted in four levels [30]. Level 1 indicates “minimal integration” where most of the interactions among trading partners are accomplished through face-to-face meetings, telephone calls, fax messages, snail mail, and electronic mail. Level 2 depicts “moderate integration” wherein participating electronic trading partners could view databases online and exchange information electronically. However, they do not have the ability to change the data in the application databases they tap into. Thus, customers could view product information, product development partners are allowed access to engineering drawings, suppliers may look at manufacturers’ production schedules, and so on. Level 3 indicates “high integration” where most of the interactions among the trading partners are electronically automated transactions between and among each others’ databases and computer business applications. These electronic transactions could alter the information stored in the databases and trigger activity in certain business applications. For example, a manufacturer’s material resources planning (MRP) system could automatically trigger online purchases with its primary supplier’s ordering systems, without any human intervention. Finally, level 4 depicts “very high integration” requiring much tighter levels of connectivity between each others’ business processes and workflows to allow highly reengineered and very streamlined data exchanges between and among databases and business applications, thus, eliminating redundant steps and activities and cutting cycle times. Major auto parts supplier, Johnson Controls, Inc. (JCI), for instance, has synchronized product development and manufacturing processes with Chrysler. Johnson’s electronic links with its suppliers and with Chrysler allowed it to build a cockpit for the Jeep Liberty in about three hours, quite a feat achieved considering that this module has 200 possible combinations.

4. Collaborative Commerce in a B2B Exchange: E2Open.com

Industries involved in the manufacture or consumption of electronic goods have been subject to increasingly thinning margins, thus, driving them into more intensive global sourcing and outsourcing initiatives. Complex and multi-tier value chains that have emerged in response to globalization, outsourcing, just-in-time initiatives, and time-to-market pressures have bred inefficiencies. These have taken the form of excess inventory buffers, expediting fees, high materials management costs, lost sales, and labor-intensive business processes. Market pressures demand a new way of managing these value chains.

Collaborative commerce can also be executed at the industry level through the use of a business-to-business exchange that allows many-to-many cross-company industry integration, especially when the industries involved face similar challenges detailed above. This is where e2Open, the global collaboration network for the electronics industry plays a role. About 600 firms worldwide, which include customers, suppliers, service providers, and other business partners, involved in the manufacture and consumption of high

technology and electronics products currently use the e2Open.com exchange. A number of notable exchange participants include leading electronics companies such as Acer, Hitachi, IBM, LG Electronics, Lucent Technologies, Matsushita Electronic (Panasonic), Nortel Networks, Seagate Technology, Solectron, Toshiba, Mitsubishi Electronic, Omron, Ricoh, Sanyo, and Sharp.

The foundation of the e2Open integration network is a combination of collaborative commerce applications and integration platform infrastructure software to deliver multi-enterprise process management capabilities. Both rely on the open, standards-based Service Oriented Architecture to support real-time data synchronization, provide visibility across the value chain, and oversee such complex processes as channel management, sourcing, product life cycle management, and other inter-enterprise boundary spanning activities. The e2Open global collaborative network is also meant to overcome the huge expense, long implementation cycles, and onerous technical requirements of earlier versions of proprietary private trading exchanges.

In March 2003, e2Open announced that it was joining forces with IBM to provide a Web services based solution to more effectively address cross-enterprise collaboration and integration issues. The solution will combine e2Open's applications and network infrastructure and IBM's e-business middleware (WebSphere products), hardware (IBM eServer pSeries* and xSeries* hardware), IBM's DB2* database software for data management, and services to support both buy-side and sell-side process integration and expeditiously build collaborative trading communities or hosted private trading exchanges. The solution will leverage key IBM technologies such as its WebSphere Business Connection product. This solution intends to meet escalating demands of e2Open members for integration both at the application and infrastructure levels. At the application level, member firms would want to be able to tightly coordinate data and transaction, physical process, and activity schedules at various points in one or more supply chains of which they are a part. At the infrastructure level, the member firm would want to have real-time collaboration with trading partners wherein each trading partner is able to converse in its own native format and is able to preserve their existing internal business processes as well.

The Web services-based architecture model is premised on a number of advantages that supersede those offered by the more traditional proprietary integration methods: simplifying deployment; reducing the costs of integrating very different systems and applications; and allowing firms to post information that would be easily accessible to its trading partners. The Web services-based architectural model has the following requirements:

- (1) UDDI-based directory: e2Open developed its own process directory based on UDDI standards to manage complex information exchanges required in business partner integration.
- (2) Ease of deployment: e2Open members will be provided downloadable tools for automatic connectivity, registration, publishing, and testing.
- (3) Scalability: Web services-based application integration software will be flexible and scalable to support a wide range of integration possibilities from simple, low-cost connectivity to deeper backend integration among many applications, business processes, and systems.

- (4) Security: IBM's Tivoli Systems' security software will provide security and authentication to protect mission-critical information and business processes across all participating electronic trading partners.

5. Strategy for Creating and Maintaining "Trust" in Collaborative Commerce Relationships

Two surveys conducted in successive years, 2001 and 2002, revealed that the main concern of early c-commerce players is "trust" for their chosen trading partners ([30],[31]). This chapter will articulate the concept of "trust" based on conformance to performance metrics and the use of the appropriate technological infrastructure.

The nature of c-commerce activities is such that firms participating in this initiative need to have relationship attributes that fit the relational exchange model that values long-term and cooperation relationships rather than merely mirror short-term, opportunistic, and transaction-based interactions. But there are dilemmas to be faced. For instance, it is quite possible for firms to be thrust together in a collaborative situation without first having the developmental experiences that accompany the "evolutionary model" of transitioning towards a more trust-based and long-term relational encounters. Lambe and Spekman [32], therefore, present their case that organizational mechanisms need to be in place to develop trust in what they refer to as "interimistic relational exchange" (IRE) as opposed to "enduring relational exchanges" (ERE) encounters. They observe that the nature of recent business-to-business activities in the marketplace has taken a different turn in that firms no longer have the luxury of time to go through the normal stages of the evolutionary model that lead to stable "relational contracts" that need to govern the exchange process.

According to the relational exchange literature, the time issue is very important in the formation of these relationships for three reasons. First, time bounds the number of interactions possible between trading partners, which limits the firms' ability to cultivate deeper relationships. Second, research indicates that the quantity and quality of interactions determine how the relationship will develop, especially in terms of one of its aspects, which is communication [33]. Third, the interactions between firms become subject to "time-compression diseconomies" when relationships are artificially pressured to develop quickly [34].

Nevertheless, in the current marketplace, the basis of competitive advantage has changed and the prize has gone to those who firms who have the "social capital" to engage in collaboration and swiftly deliver the products and services that best fit customer demands. Interimistic relationships or IRE have emerged as a result of this need to be able to collaborate within compressed time spaces. Lambe and Spekman [32] argue that IREs are also another form of relational exchange because they require high levels of cooperation, adaptation, and joint planning. The question is, though, how to govern IREs in the presence of "time-compression diseconomies." Both authors argue that IREs need to use nonrelational as opposed to relational governance mechanisms such as norms or personal relations. Three nonrelational governance mechanisms that they propose are: (1) prior extraexchange relationship interactions, (2) a reputation for fair dealing, and (3)

pledges. Prior extraexchange relationship interactions refer to past positive interactions with the partner in other exchanges that could contribute to trust to the current interaction in question. A new partner's reputation for fair dealing could assist greatly in setting the right tone for newly initiated business interactions. Also, counting on a firm's public reputation as a social control mechanism works here because it is a commonly accepted value in business that failure to perform puts one's reputation at risk. Finally, pledges refer to specific actions that bind a firm to the relationship; these are more than simple declarations of commitment or promises to act in good faith. This chapter proposes the use of pledges based on performance, the measurement of performance, and conformance to agreed upon metrics specifically in establishing trust in e-commerce relationships.

5.1 Determine Performance Metrics to be Used

Participating firms in the supply chain first have to determine which metrics and measurements are relevant to their value chain activities and address three fundamental [35].

a) Target value chain business processes

A firm needs to measure collaborative interactions with electronic trading partners and identify nodes in the chain of activities that represent bottlenecks or inefficiencies resulting in increased costs, delays, lower margins, and underutilized resources. Measurement usually begins right after a purchase order is negotiated up to the time the goods are delivered to the customer, be this an individual or a firm.

b) Clarify firm's role in the value chain business process

It is possible for a firm to assume one or more of the three possible roles in the value chain: supplier or service provider, intermediate processor or broker, and buyer. The supplier originates the product or service in the value chain. The broker or processor serves as an intermediary handler in a process; for instance, a trucking company is involved in outbound logistics. Finally, the buyer is the purchaser of the good or service. A firm could be participating in multiple value chains at one point in time and could be assuming one or a combination of the three roles in each of the value chains of which it is a part.

c) Define value chain business process metrics

Gartner Group has articulated three sets of performance metrics consisting of operational, innovation, and risk metrics, which firms engaged in e-commerce could use. Eventually, selected performance metrics must be shared with value chain trading partners and must be managed under a mutually supported an umbrella value chain management program embraced by all affected firms.

Operational metrics generally refer to four different types of measurements:

(1) time measures tracking delivery commitments at selected nodes in the value chain; (2) quality measures indicating completion of commitment, degree of rework, etc.; and (3) cost

measures show the costs of business processes or deliverables; and (4) connections and relationships show how a firm leverages its collaboration and the supply chain as a whole.

Innovation metrics could be broken down into its two components: (1) improvement trends and patterns indicating major beneficial changes introduced by the firm and (2) operational trends involving selected operational metrics.

Risk metrics is indicated by two indicators: (1) immersion or the level or degree to which a firm's activities are conducted through value chains and (2) "co-opetition" or the inclusion of a firm's competitors in the value chain (Figure 2).

Operational Metrics	Innovation Metrics	Risk Metrics
Time On-time delivery against commitment Interim delivery or staged order acceptance Overall time or throughput time reduction Cycle time reduction Availability of information for near-real-time decision support Cost Total value chain cost Selected processing costs at selected nodes Interoperability costs (e.g., ASP, messaging, wireless) Cash flow Dollar value of time variance Asset utilization (resource wait time, inventory days of supply, inventory runs, net asset turns) Quality Delivery quality against specifications Specification completeness or purchase order quality Cost of rework Connections/Relationships Number of partners Number of touch points Number of collaborative processes Number of steps in process	Improvement Trends/Patterns Promised dates vs. actual dates Impact of change vs. goals for the change (e.g., marked share increase, throughput increase, cycle time decrease) Operational Trends/Patterns Unit cost trends Throughput or productivity goals Transaction or delivery growth goals Multidimensional analysis (scalability, e.g., as volume requests increases, does cycle or completion time remain constant?) Number of partners trading or collaborating electronically	Overall Cost to enter relationship Cost to switch or change suppliers or providers Partner dependency Partner acquisition time % of growth or productivity increase from value chains % of neutral revenue (revenue independent of chains) % of market share dependent on value chains

Figure 2. Three Performance Categories: Suggested Metrics [35].

e-Collaboration, Technological Innovations, and Support

Finally, once performance indicators have been mutually agreed upon, these indicators should be embedded in the trading partners' business agreements so as to pave the way for a systematic and sustainable way of monitoring the collaboration [36]. Participating firms in c-commerce should understand that before cross-company metrics could be implemented, they as a firm should understand performance measurement as both a concept and practice and have in place, accurate and reliable data that they could exchange with their trading partners. Figure 3 shows a list of relevant performance metrics involving manufacturing planning [37].

Traditional Indicator	Enterprise Measure	Collaborative Impact	Collaborative Indicator
Forecast Accuracy	The percentage difference of predicted vs. actual demand	Increased external visibility to forecast creates larger imperative for accuracy	Increased accuracy indicates c-commerce readiness
Inventory Accuracy	The percentage of items for which system inventory and physical inventory differ	Collaborative planning will be based on collective inventory information; failure to provide accurate data will erode relationships and drive up supply chain inventories	Increased accuracy indicates c-commerce readiness
Time Fence Adherence	The percentage of orders completed that were inserted into the schedule after the schedule was frozen	As supply chains become more synchronized, short-term changes will ripple throughout participants and lead to inventory buffers and poor customer service	Short-term demand stability indicates c-commerce readiness
Lead Time	The average time from customer request and authorization to customer order receipt and installation completion	Lead time will be measured for the organization and the supply chain, measuring total time from sourcing through production and distribution	Reduction in lead time across the supply chain indicates a more collaborative community
Work-in-Process Inventory	The ratio of in-process inventory dollars to average daily sales dollars	WIP will be measured in terms of the supply chain in addition to the organization; enterprise initiatives that push inventory on suppliers can no longer be judged as successful if they create problems elsewhere	Reduction in WIP across the supply chain indicates a more collaborative community
Inventory Turns	The ratio of annual sales dollars to inventory dollars on hand	Collaboration will reduce the need for inventory buffers between enterprises	Reduction in inventory across the supply chain indicates a more collaborative community
Constraint Utilization	The ratio of time that critical work centers/machines are in use to the total time available for use	Available capacity data on key constraints, will be used in nontraditional e-markets and exchanges to drive up utilization and	Knowledge and management of constraints indicates c-commerce readiness

		gain business from noncore customers	
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Figure 3. Manufacturing Planning Performance Metrics [37].

Another source of ideas for defining performance metrics is the three-level Supply Chain Operations Reference (SCOR) model, which is used to compare a firm's effectiveness with those of other firms [36]. SCOR is applicable to various industries and across different levels of complexity and covers:

- “*All customer interactions---from order entry through paid invoice.
- *All physical material transactions --- from the supplier's supplier to the customer's customer, including equipment, supplies, spare parts, bulk products and software.
- *All market interactions --- from the understanding of aggregate demand to the fulfillment of each order.”

5.2 Bolster Trust Using the Technological Infrastructure

The design of the information technology infrastructure supporting the c-commerce initiative also has a bearing on the levels of trust that will be engendered among its participants. Private trading exchanges are considered environments with relatively high levels of information security because membership is closed and participants have been carefully screened by the hub firm. For this reason, they have garnered reasonable market success even after the Dotcom crash. Meanwhile, early versions of many-to-many electronic marketplaces allowed higher levels of information transparency which has actually led to the drop in participation, specifically of high-cost suppliers. In effect, such suppliers have mistrusted these environments because information such as product prices, competitive bids, available product quantities made available in real-time has lowered their negotiating leverage and shaved potential profit margins. It behooves e-marketplace owners, then, to redesign the microstructure and operating business rules in these environments [38]. On the flip side, suppliers, for instance, should demand selective information opacity in these environments to protect their interests and relationships. Technological features of B2B exchanges such as support for reverse auctions, extensible markup language (XML) mapping, and data management determine the data disclosure rules put in effect. One way to protect data confidentiality would be to require buyers and suppliers to pass a validation check, in addition to the routine registration procedure, to secure membership in the exchange. Member firms in the exchange should also be able to identify trading partners who will be allowed access to varying levels of granularity of certain data sets. Member firms should also be able to show pending active transactions on the B2B exchange before they are given additional information access. The exchange could also use intelligent agents to reveal, for instance, product availability within certain time windows rather than revealing raw data on inventory stock levels at every point in time.

Using e-marketplace design techniques enhancing information security such as those suggested could help raise perceived trust levels among trading partners that subscribe to such environments.

Conclusion

This chapter has accomplished a number of things. The phenomenon called “collaborative commerce” has been described and clarified as the “next-level” implementation of e-commerce. Theoretical frameworks used in management have been used to explain the appropriate organizational designs that accompany the emergence of configurations of firms engaging in collaborative commerce. Finally, appropriate governance mechanisms that promote trust within collaborative commerce initiatives have been suggested.

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e-Learning

Building Post-Secondary Teaching Support with Modest Collaboration and Workflow Tools

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Abstract: We describe tools that attempt to streamline the tasks associated with more traditional classroom education and which do so via inexpensively. Our approach considers where the most gain in productivity can be made for the least effort -- a Pareto optimization. In practice, this has mainly implied computer and network-mediated tools, so far for homework submission and return, recording and correction of marks by multiple professors and assistants, replacement of consultation and communication with students, traditionally referred to as "office hours" with Web for a, and the provision of pedagogical materials and administrative information to students and other members of the teaching team. Our current suite of tools is a mix of externally developed and locally built software, the latter based on a standard LAMP (Linux, Apache, MySQL, PHP) server -- in fact a discarded Pentium II-400 retrieved from the junk room nearly three years ago.

Motivations

Our study is but one aspect of the investigation by many workers into the use of information technology (IT) to improve productivity in "office" work where our "office" is the university classroom. Unfortunately, the majority of "easily found" materials, that is, those accessible by simple Internet search, are limited to standard, off-the-shelf office-suite packages. See, for example, the links on <http://t3.k12.hi.us/t302-03/resources/prod.htm>, which aims to provide productivity tools for teachers. Such a collection ought to be relevant to our own example situation where we are concerned with the delivery and workflow of courses in statistics, forecasting and government on-line. The introductory statistics courses, in particular, involve multiple professors (currently 5) and teaching assistants (8) providing lectures, laboratories and marking to many students (approximately 600). Our courses are largely delivered in a traditional lecture / tutorial fashion, though we also want to "teach from the back of the room" to be able to discover weaknesses in student abilities to solve problems.

The main operations that requires a great deal of "busy work" in our traditional processes were

- 1) the hand-in and hand-back of assignments, complicated by "noname", "wrong section" and "late" papers, as well as the logistics of movement and mislaying of papers, especially in the context of requests for regrading;
- 2) student consultation with professors ("office hours");
- 3) dealing with the administrative issues such as illness or reports of cheating, inappropriate behavior, or similar eventualities.

Note that the tasks described have many aspects in common with most "office" and industrial situations. However, we would like tools that can be tailored to our tasks. Moreover, given that our resources were and are limited, we want tools that require limited financial, IT and human effort resources.

1) Early Explorations

We were fortunate that our interest in exploring the use of such lightweight IT tools for workflow improvement coincided with

1) the availability of moderately powerful personal computers as "surplus" to institutional needs so that they could be redeployed for the needs of this project. To paraphrase, we were able to raid the junk room to obtain two Pentium II 400 class computers. Each had a hard drive of several gigabytes, a CD ROM and an ethernet port. A monitor and keyboard were needed for setup, but after setup, most maintenance was done via a "remote" connection, even if only across the room.

2) the rise of the open-source movement [1]. This provided a software infrastructure on which we could build our specific tools. In particular, we have used the standard stable version of the Debian Linux distribution (<http://www.debian.org>) and did not install the X-Windows graphical user interface on these systems to minimize overhead. For security, access is permitted only via the http and ssh protocols.

At this point, we want to make clear that the tools we have developed are not unique in their capability. Our goal is to explore the application of lightweight tools we could use, adapt or implement easily, not IT tools in general. For our teaching purposes there exist a number of well-known "solutions" such as Web-CT, Blackboard and others. There are also open-source -- in fact, free to acquire -- alternatives such as Moodle (<http://moodle.org>), Manhattan Virtual Classroom (<http://manhattan.sourceforge.net/>) Claroline (<http://www.claroline.net>) and others. These approaches may in many instances be more appropriate than our own for most users. However, they are largely complete suites or systems for course management, rather than individual tools. We may liken them to a workshop of power tools rather than a toolbox of hand tools. While we could and did look at some aspects of such systems to give perspective to our own work, we did not adopt them for reasons of

- 1) size and complexity of the systems;
- 2) difficulty of tailoring them to our needs or to adapt to our style of operations. (An example is our need to retrieve whole class sets of assignments rather than access each student's work individually.)
- 3) costs, learning time, support and maintenance effort to implement and use;
- 4) stage of maturity when we were ready to proceed (2001).

If we were to begin our investigations now, it is almost certain that we would borrow more ideas or software from some of the open source offerings above, as there has been a steady evolution of all the products. While it is difficult to gauge the internal directions of software projects, it is our opinion that few, if any, give simplification a high priority, especially compared to the pressure to add features.

On the other hand, though the University of Ottawa offers WebCT and some support for its use, we have eschewed this possibility:

- An earlier offering (First Class) was abandoned by the University after we had invested time and effort in its use.
- The business model of some of the commercial players has been reliably reported to us as “offer it cheaply, get them hooked, then put up the price”. From a private conversation with someone who does not wish to be identified, this has apparently been the approach of WebCT.
- Commercial vendors generally insist on clients updating their software, even if this means work for the users. With the recently announced merger of WebCT and Blackboard, we may anticipate that the software will change and users need to adapt.

Given the dominant role of statistics courses in the early stages of this project, the general concepts of statistical process improvement have given context to much of the development. For example, the Schewart cycle “Plan, Do, Study, Act” is one way, among several, to view our approach [2].

2. Tools developed by others

To provide materials and announcements to students (and also to members of the teaching team) we use a simple file repository that has separate directories for each course and for staff functions. This may be accessed as a virtual disk drive over a local network on campus, or via a Web-interface driven by some simple php scripts that were created under contract for the entire School of Management. This facility, called ***Doc-Depot***, has been extremely successful, largely because of its eminent simplicity of design and access.

We use ***phpBB*** (www.phpbb.com) to provide forums for students to pose questions, share ideas, and communicate with the teaching team either in public or private postings. This is one of the most popular of the Web-based “bulletin boards”.

3. Home-grown tools

The difficulty of recording marks for multiple sections of a course by multiple markers and professors motivated the development of a collaborative infrastructure allowing multi-user access with audit trail to a spreadsheet. This TellTable system (www.telltable.com), while initially conceived for marks recording, has been extended to offer much wider and richer collaborative possibilities that go beyond the current application. A number of papers are referenced on the web-site. The software is an open source project on SourceForge, namely telltable-s.sf.net. Because we have several articles about TellTable which can be found from the TellTable web site, we will not discuss it further in this chapter.

We developed two systems (ETPRL and ETPHP) for the submission and return of student assignments. These are part of the SourceForge Etutor project (etutor.sf.net), though at the time of writing there is an ongoing major review of the software to incorporate lessons from the first three years of use. We will examine these tools in more detail below and show why both have appropriate uses.

Co4 was our attempt at a simple web forum. It was prepared in Perl and has been upgraded from time to time. It is compared with phpBB2 in the next section.

Two minor tools we developed were CONFORM, a simple contact form for use by students to get in touch with the course coordinator(s), and PICKSEAT, a tool for selecting a classroom seat at random when a “volunteer” was needed to answer a question or work on a problem. The special nature of PICKSEAT and the possibility of private messaging in phpBB2 have minimized the utility of these.

4. Web forum comparisons

From our experience, we can, in retrospect, present the attributes of a web forum suitable for student technical, course content, and assignment questions.

- Many contributors should be able to connect and post messages, questions or other contributions.
- Contributions may include images and sounds.
- A moderator may reorganize and edit material, as well as discard outdated contributions.
- Edits should be protected in some way so that two users do not both try to write to the same contribution at the same time. We refer to this as file locking, but our usage of this term is broader than that usually applied in computer science.
- It should be possible to segment the forum, e.g., into "Assignments", "Exam questions", "How Tos", "Find Collaborators or Group Members" etc.
- Web pages sent to the user should not be so "large" that they are slow or impossible to load.

Our trials have involved Co4 and phpBB2. These are quite different in their approach and structure.

Co4 presents each "forum" (really each segment of the overall collection) as a single linear collection of sections. New sections can be inserted between the existing sections, or at the beginning or end of the forum. It is easy to insert images into sections and to size them. Other files can be uploaded, with links inserted easily. Thus sound files or other data can be provided. However, Co4 does not prevent two users with write access from trying to edit the same section simultaneously. This can cause corruption of the underlying files, so Co4 is best suited to fora where there are few "authors" but possibly a number of readers. The current version of Co4 does not identify the section author in the display, though this information is stored and is used to control access since some users are permitted to edit only their own contributions.

Clearly as sections get added, the forum (segment) may become large. Thus Co4 allows the user to specify the number of sections to display in order to allow quick rendering of the material. The user may choose to overlap some sections when "scrolling" to the next set of sections. To allow for organization of the material, Co4 allows users with appropriate privileges to move sections up or down or to the top or bottom of the whole set.

The strengths of Co4 are directed to building a coherent "document" on a topic. It has worked extremely well for recording travel photos and stories, and does well for expositions on a particular topic, including software documentation. Users can edit and revise material, rendering the "document" more readable and useful. However, this comes at a cost of losing the intermediate contributions and the time-line for the introduction of material.

Our chosen alternative for course bulletin board, phpBB2, by contrast to Co4 works very well for recording contributions ("postings"). These are most easily submitted in text format, though one can configure phpBB2 to handle HTML code with links to images, generally on other servers. We have not promoted this, as our students are not generally comfortable with inserting tags etc., and we also wish to avoid the possibility that malicious JavaScript is inserted. At the time of writing, phpBB2 does not allow the uploading of files for images, sounds or other data, but requires that these be provided as links on a regular web server. In our introductory statistics courses, diagrams and graphs would be very helpful, as would datasets or similar files.

On the other hand, phpBB2 presents all the postings and replies in chronological order. The moderators can edit postings to merge or tidy several contributions, and they can move items within and between forum segments (e.g., between "Course Material" and "Assignments"). We can also retire material easily, either manually or automatically. Multiple contributors do not suffer "collisions" in phpBB2.

We continue to seek a system that is like phpBB2 in its handling of postings, but which allows images and other files to be displayed in or linked to these postings. However, even in its present form, the phpBB2 technical forum for our introductory statistics courses has resulted in an extreme (>90%) reduction in the number of "customers" to office hours of the professors. In part, this may be due to a well-publicized policy that questions of the type "Is this on the exam?" or "How do I do question 3 on the assignment?" will only be answered there in the interest of fairness to all students (and incidentally to reduce the teaching team's

need to repeat answers).. However, students are using the forum for asking a number of "How To" questions. Even better, students as well as some teaching assistants are contributing answers. There are, of course, a number of students who will post a question that has already been answered (possibly several times) rather than scan the existing postings. We have found it helpful to organize the overall forum with sub-sections for individual assignment questions.

Sometimes students will make inappropriate critical remarks about postings. Fortunately, we have had very little bad behavior on the forum. We note that our students also have access to optional "lab" classes where example problems are solved, though these have been part of the course for many years.

5. Homework management

The task that has most engaged our attention is that of homework submission and return. The essence of this is

- gather student assignments
- mark them
- record marks
- return marked assignments
- handle requests for regrading.

The processes involved in these steps allow for numerous errors and occasions for losses. In particular, students miss deadlines, omit or mis-enter course or section identifiers, names, student numbers or other important information, or they mis-format or otherwise incorrectly prepare their work. Return of paper assignments is problematic when students are not present to receive their work. "Pick up" arrangements require staff or else the trust that students will only pick up their own work. (We observed that there was a high rate of disappearance of scripts with high marks when we used a "pick up box". Our hypothesis is that students were stealing them as a guide for study.)

In the Fall 2000 trimester, we tried email submission of assignments. This imposed a large amount of work on the recipient. Students generally failed to use a filename that was linkable to them, that is, Assignment1.pdf rather than 3245678-a1.pdf. They also frequently omitted their names inside the file, and sometimes used email accounts that were uninformative, such as the extremely shy woman who used "funkyckick" as her email identity. On a purely technical level, the volume of data was too large for the mailbox disk quota, and the operations of saving, renaming, and sorting files to delegate them to the correct marker were extremely tedious. Return via email was not automated, and we did not attempt it.

A better solution, for small classes at least, is submission using File Transfer Protocol (ftp). We tried this with a single account for a course. It is fast and relatively simple, but the single account means that only one student at a time can upload, and that student must log out before another can connect. Multiple accounts are possible, but their management is a

nuisance. Furthermore, students are not generally familiar with ftp client software and its usage, nor variants based on more secure protocols such as scp or sftp.

A web-based file upload to a server is a much more attractive option.

- 1) Via a login, the student ID is available and can be linked to the file(s) that are uploaded.
- 2) The same login can be used to return work to students.

Return of work electronically requires marking "on the file", which we are able to do quite easily using the "writer" version of Adobe Acrobat. As a result of the acquisition of a Wacom Tablet to help avoid conditions that aggravated arthritis pain in my hand, we discovered that Adobe Acrobat allowed handwritten annotation of pdf files. Acrobat also allows typed notes to be added to pdf files. These annotations do not change the pagination or layout, so avoid the possibility of alteration of the student's work that may occur even by simply opening a word processing file. Moreover, the layout of word processing files may be highly dependent on the default printer in use on the machine used to create the file. We have seen quite serious repaginations and movements of graphs. Therefore we restrict submissions to pdf files. We provide a "How-To" file with a number of free methods to create pdf outputs on our Doc-Depot file repository, and also try to discuss the subject in class and in laboratories. However, we find many students have very limited computer skills and awareness, despite claims to the contrary. A recent phenomenon in the opposite direction is the uploading of files prepared with advanced versions of Adobe Acrobat that "protect" files from alteration. This vitiates the marking process, so we now have to discourage "fancy" options. In fact, the favoured choice seems to be to use OpenOffice writer to prepare the final submission and to use its "Export to pdf" facility that prepares compact and straightforward files. As an open-source advocate, it is painful to admit that a good open-source option for "writng" on pdf files is as yet not available.

In building our homework management tools, we tried two designs:

- 1) ETPRL, a file-only system written in Perl. The first attempt was written by Pat Suwalski and Markus Svilans, then extensively rewritten by John Nash [3]. ETPRL currently consists of 180K bytes of Perl code, operating data, and image files. It requires a web server and Perl interpreter on the server.
- 2) ETPHP, a database-supported system written in PHP (<http://www.php.net>, with history at <http://ca3.php.net/history>) that makes use of a MySQL (<http://www.mysql.com>) database to hold all login, course, assignments and content. This system was written by Pat Suwalski and Markus Svilans based on their experiences with ETPRL. Minor modifications have been made by the author, and more extensive work is ongoing with the assistance of Trevor James. The code size is roughly double that of ETPRL.

Both these designs have proven useful and workable. They have slightly different cost and benefit profiles, so we have retained both in our "toolbox". ETPRL, since it uses only files, avoids any limitations that are built into MySQL or other database system. Furthermore, the operator does not need to know how to deal with database issues - a lower learning cost. It therefore appears that ETPRL is easier for professors to use for this and

similar complexity reasons. However, each submission task is separate; there are no courses or sections as such. This means the student login file must be generated for each such task. This is not a huge problem – the file can be copied – but it is not perfect.

The ETPRL login issue would be cured with a common campus-wide login system and there would also be efficiency gains for ETPHP. The login components of all our own systems are quite modular and could be replaced. The organization of each assignment under a single professor means that multi-section courses are more awkward to handle than in ETPHP that was designed with these in mind. This deficiency could be overcome, but at the cost of more complexity in the program code. A further issue is the need for a better installer for ETPRL.

Some strengths of ETPRL are that files are available directly – we use `sftp` to recover them for backup. We have also found ETPRL could be run under the Abyss web server for Windows (www.aprelum.com), while initial trials of ETPHP were unsuccessful on Windows (this is most likely an issue of PHP and MySQL setup on the Windows platform).

ETPHP has proved more suitable for multi-section courses, since it can use the structure of a user database to allow students to simply log in without requiring that they know the section in which they are registered. (We have discovered that students commonly do not know their section identifier. Submissions to the wrong section of paper scripts were a source of much wasted time.)

A particular strength of ETPHP is its plug-in architecture. Plugins are small program units that can be added easily to a core application. They allow for focused extensions of an application, allowing incorporation of missing elements that may disadvantage small units of disjoint software. In our case, they are lightweight and are provided with very basic structures. Each plugin is intended to perform a limited task, rather than add core functionality, which we contend belongs in the main program for both security and consistency. An example is the Batch Return plugin, which streamlines the main assignment return mechanism that uploads one file at a time.

One task that is not yet integrated as a plugin is that of backup of the student files. We have prepared simple php scripts to do this, though at the moment these rely on rather cryptic assignment identification numbers that must be retrieved using a utility program (`phpmyadmin`). The extractor renames all files to a common naming convention of the form `1234567-s225.pdf` for the submitted file of student 1234567 for assignment identified by sequence number 225. The marked version of this would be `1234567-m225.pdf`.

As indicated, all our systems would benefit from a centralized login. We have been seeking this for over five years, and continue to request its implementation since the presence of multiple login systems with multiple passwords is a burden to both students and system administrators. We regard this as a political rather than a technical problem, since other institutions, including neighbouring Carleton University, already have workable single login systems, and some efforts are in progress to rectify this situation.

6. Observations and outcomes

Homework Management

Both our homework management systems have provided such good service that we would be very loath to run our courses without them. They benefit all parties:

- students like the ability to submit their assignments from wherever they have web access, as well as to retrieve their marked work in the same way. They are not constrained to physically deliver paper, nor to make submissions during "regular" hours. An early comment from a student was "Saves \$4 on parking".
- teaching assistants have found similar benefits in retrieval and return of homework. In particular, we recognized early in our development that a "Get entire assignment" link was very helpful. This prepares a zip file of all submissions received in a particular section of a course. We have more recently added a batch return facility, which is similarly valued though it has experienced some failures, mainly related to complex file names used by students that contain characters that are permitted under one operating system but not another.
- professors like the fact that they are no longer dealing with large bundles of papers and the attendant issue of sorting and organizing them. Indeed, the homework is largely handled by the server, the students and the teaching assistants without professorial intervention.
- the greatest time saving comes in the avoidance of movement of physical homework scripts for regrading. A student can electronically contact the teaching team and a review made. There are no delays to get the script to the professor, from professor to TA, then back to professor and finally to student, who may be absent from class on the day of return.
- The possibility of saving all submitted and returned files for all sections and all students, typically on a CD or DVD, has served us very well when students complain about absent or mis-recorded marks. Instead of having to ask the student to present their script (possibly modified!), we can simply check the file. Typical queries are handled in under five minutes, much of which is dealing with the email query and finding and loading the correct DVD or CD.

There have, of course, been some problems. In our first attempt to use the software (ETPRL) we found that students worried that their assignments had not been received, so they sent professors email messages, sometimes several times. We resolved this matter by having the uploader return the student to a web page showing their assignments including the files that they had submitted. In particular, we include the file size. ETPHP has a similar feature.

As student files and student numbers have become bigger, we discovered that there is a limitation on data transfer sizes into MySQL. (We were already aware of similar restrictions in PHP and had addressed them.) This required changing a parameter in the my.conf file for MySQL and restarting that service. In the future we hope to put suitable checks into the installer script to detect such limitations and inform the user so that the

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appropriate configuration files can be altered appropriately. We have also in some cases run out of space when teaching assistants want to do a batch return of files. Unfortunately in some cases the physical memory has been overloaded, and while the server has not “crashed”, the lack of working memory means the user gets no message at all. We hope to resolve this in the next iteration of the code, but the problem is not a trivial one.

We also discovered as volumes increased that the response time for users increased drastically for some tasks. An analysis of the database activity showed that for some operations our code was searching the entire database to collect information to display. We have since indexed the database to improve the speed of some operations.

Communication with students

The use of a forum is now becoming common in many courses. While some professors still use email communication for answering questions, in our multi-section statistics courses the forum allows many students to see the response(s) to a question, resulting in a large saving in avoided repetition. Private messaging in phpBB2 can be used to handle administrative communication, yet keep the data for a single course together in the single phpBB database. One caveat is that the backup files are very awkward to access off-line. A viewing tool for the phpBB files would be welcome.

General comments

A deficiency of all our systems is the possibility of system failure. We have experienced one disruption due to a power outage that damaged the user database of ETPHP. Since then we have installed uninterruptable power supplies on both our servers. For a trial of our contact form system we programmed and installed a simple automatic backup to another server once an hour. We would like to install a similar service for ETPHP files, but in number and size they are much larger, so require more than a brute force backup if we are to avoid tying up machine and bandwidth resources that can be used to serve our clientele.

From the point of view of results obtained, the small, disjoint tools we have been implementing or applying have been highly suitable to the minimal development and maintenance team. While there are several applications to maintain, each is relatively independent of the others. The number of scripts to examine when a “bug” manifests itself are relatively few, so repairs are generally quite rapid. Truthfully there have been less than one per term on average, and only one fixed a security flaw. (This was a logical error in adding a feature for professors, so was a “fix” creating a bug.) Moreover, we are able to incorporate new functionality quite quickly when a need is perceived. This reduces the concern that action in one part of the code may disrupt operations elsewhere. Thus, for our needs, small disjoint programs are better than full-blown, integrated solutions.

Conclusion and prognosis

As there is active, ongoing modification of our tools to improve them, our justification for their continued use requires very obvious benefits to at least some of the participants and no disadvantage to any. We were gratified that, in one instance, teaching assistants approached a professor who proposed to use a traditional approach and asked if they could instead use one of our tools. Clearly this is anecdotal justification, but this investigation concerns feasibility and acceptability rather than a comprehensive comparison to either traditional work methods or to popular IT-based tools. Indeed the cost of an evaluation would likely exceed our total development costs. Our experience to date has been very positive; despite some "glitches" and mis-steps, several tools have become a regular part of our course operations that we would miss if they were withdrawn.

We do not envisage large-scale changes to the tools we have developed. Indeed, our plan is to tidy, document and package them so they are ready for quick and painless use by others. We fully expect this "packaging" to be as much work as the tool development so far. We also see the possibility that our tools are amplified in power by using them in concert with other tools and systems, such as our TellTable system for auditable and collaborative editing of office suite documents and spreadsheets. Nevertheless, even ignoring these possibilities, we consider our progress to date worthwhile and successful.

Acknowledgements

The initial programming of ETPRL and ETPHP as well as some other tools not described here was funded by a Teaching and Learning Grant from the University of Ottawa. Some of the justification for this grant was drawn from a feasibility analysis prepared by Karen Leblanc as a directed reading study. Lawrence Taylor and Camille McCarthy wrote the initial "proof of concept" of Co4. Testing and review by Mary Nash suggested numerous improvements and simplifications. We are very grateful to Woody Suwalski for supplying a surplus Rebel Netwinder that became the "macnash" server when the original Macintosh Quadra 650 became insufficient. The School of Management also funded the "courses" server and monies to allow Leigh Craig-Browne to install the Debian Linux and act as sysop for the first year. Other funding (e.g., for network connection, maintenance work, and similar costs) has come from the personal research account of one of us (JN) and the Management Section of the School of Management has purchased two Wacom tablets and two copies of Adobe Acrobat Standard (version 6) to allow teaching assistants to mark assignments on screen, as well as furnishing a second surplus PC to replace "macnash" when the disk in the Netwinder failed. Recently Andy Adler contributed a new server so that experiments with TellTable could continue on "macnash". Neil Smith, Andy Adler and Sylvie Noël have been critical to the development of the sister project TellTable. Patrick Suwalski and Markus Svilans did much of the early programming, particularly of the homework managers. Richard Zhang investigated and analyzed the tools, made a number of improvements, and wrote the CONFORM package. Trevor James has been assisting in the current review and revision exercise.

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Mobility vs Stability: What's coming next in the implementation of e-learning processes?

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Working Paper

Introduction

Mobility is now a popular catchword not only in the realm of information and communication technologies but also a pervasive and ubiquitous term in contemporary society. Kopomaa (2002) points out that pervasiveness and ubiquity as two main characteristics of mobility have become part of human life at both personal and institutional level. Closely related to *mobile* and *mobility* is the notion of '*nomadic information environment*' recently coined by Lyytinen and Yoo (2002) to illuminate the magnitude of pervasiveness and ubiquity of mobile types of work that have enabled the digitalization, miniaturization, and integration of information sharing on the move (Wiredu, 2005).

Knowledge and learning emerging from the individual and collective expertise of employees are largely accepted as the major source of sustainable advantage for most organizations (Leonard-Barton and Sensiper, 1998; Nonaka 1994; Skyrme and Amidon, 2002).

In this context a particular emphasis is given to ICT technologies which are seen to play an enabling and facilitating role in work and learning processes within or beyond organizational boundaries (Wiredu, 2005). Davenport, Jarvenpaa and Beers (1996) identified five different knowledge processing modes in mobile contexts which are associated with different objectives: acquisition, that is the process of searching, finding and understanding new knowledge requirements; creation, involves the generation of new knowledge; packaging focuses on the accumulation of knowledge created externally to a process; finally the processes of applying or using existing knowledge and the process of reusing existing knowledge aim to leverage as much as possible prior knowledge.

Although these processes are conceptualized to result in improved understanding and improvement of organizational capabilities, yet mobile processes also present challenges

manifested in the complexities and uncertainties generated in information processing interactions (Mathiassen and Stage 1992; Sorensen et al, 2002).

Kleinrock (1996) argues that one major challenge is a widely noticed tendency by e-learning actors to become focused on an oversimplified version of anytime, anywhere use of ICTs; however, the efficacy of a portable computer depends largely not only on the appropriacy of the ICT means but most importantly on the fundamental pattern of combined functionalities including physical, systemic and interfacial aspects of the communication that e-learning participants need to enact in order to perform or support an activity (Kleinrock (1996; Sorensen et al, 2002). In other words it is the human aspect of mobility that counts most.

1. Dimensions of mobility and Enablement of mobile learning

In the mobile learning landscape the theorization of the significance of the dimension of human mobility is conceptualized by Kakihara and Sorensen (2002b) within the dimensions of space, time and context. Any analysis of mobility has to deal with questions about where, when, and under what circumstances (Kakihara and Sorensen (2002a). Mobile learning is not a simple metamorphosis of static or mobile computing; it involves an integration of complexities related to communication services supported by ICTs and frustrations caused by human interaction leading to the development of highly dynamic interaction processes (Kakihara and Sorensen, 2002b). A discussion of the core dimensions of mobility will give us a better understanding of the integral aspects of human movement in e-learning contexts.

The spatial dimension

This is perhaps the most important dimension of mobility as we can not understand mobility without referring to location. E-learning participants are expected to become geographically independent, nevertheless, socially interdependent, nodes in a network of cooperation supported by the 'wirelessness' and portability of ICTs (Makimoto and Manners, 1997). In this context mobility is identified as a fundamental attribute of not only aspect but also includes the portability of objects; objects, the portable ICT means used for the enablement of communication across space boundaries are carried by humans to mediate certain activities and thus enable the fulfillment of particular needs, interactions and motives (Castells, 2001). Wingberg and Ljungberg (2001) point out that the essence of spatial mobility of ICT objects gives meaning to the spatial mobility of humans; for example, an individual that uses a laptop computer or carries a PDA certainly does so with the intention to use the service provided by the mobile object in order to perform an activity aimed at satisfying a particular motive.

Temporal dimension

The conceptualization of temporal mobility has always focused on the idea of automation of processes (Zuboff, 1988); to 'automate' means literally to enable the application of time saving processes with the use of either static or portable ICT means. The temporal efficiency established by the use of static ICTs, e.g fixed telephones or paper-based mails, allow for asynchronous and synchronous communication but confine the user to a specific location and incorporate time delays (Zuboff, 1988). On the contrary, portable ICTs which give particular emphasis to the enablement of synchronous interaction as they are wirelessly connectible and mobilize information processing at a polychronic level of action (Cotte and Ratneshwar, 1999). The treat time polychronically enables e-learning participants to deal with multiple tasks at the same time and therefore exhibit polychronicity as opposed to monochronic action which involves the treatment of time as a sequence of linear and separable events happening one at a time (Cotte and Ratneshwar, 1999).

Context dimension

The contextual dimension of mobility primarily creates links between the conventional space and time dimensions of human interaction with the support of ICTs referring to questions such as 'when', or 'where'; these questions, however, are supplemented by another type of questions such as 'in what way', 'in what particular circumstances', or 'towards what particular participants' that bring to the fore the interactional aspect of mobility (Suchman, 1987). The contextual relationship among interactions in e-learning processes can alleviate temporal and spatial difficulties which usually do not occur in face to face interactions. Every e-learning situation is likely to present a different context in which participants are forced to adapt; Kristofferson and Ljungberg (2000) point out that successful adaptation in a situational context is related to the circumstances that underlie human action as well as the continuously enriched experience gained through the participants' involvement in different contexts. In this sense the motive may remain constant but the related situational conditions may be continuously dynamic and mobile. As a result, participants need to be able to adapt in constantly changing contexts.

2. The social dimension of mobility in nomadic information environments

McDermott (1999) argues that new information systems (IS) tend to have the effect of reinforcing existing behavioural norms but do nothing to change attitudes towards open communication and sharing of information nomads; further to this view Gundry (2005) suggests that what is required for effective knowledge creation and transfer is a combined approach focused on both social and information systems.

3. Mobility and sociability in e-learning contexts of work

Gundry (2005) recognizes that participants in e-learning processes have diverse experiences and perceptions of working remotely - whether as teleworking nomads or as members of distributed groups or virtual teams; further to this view Burt (1980) points out two basic issues that are implanted in mobile interactions: boundaries and behaviors.

The boundaries issue addresses issues related to social structure hence how individual nomads come together and collaborate based on their patterns of relationships Burt, 1980; Monge and Eisenberg, 1987). Generally, the relational approach suggests that organizational systems may affect the ability of people in the organization to connect and communicate with one another based on the strength of their direct relationships with one another, a factor which is referred to as cohesion. The cohesion or relational approach is measures against tie density, strength and flow among participants. The implication is that greater connectivity and communication will improve organizational performance. The technology may also affect the nature and distribution of existing links (Zack and McKenney, 1995). Hence, technology is used to facilitate not only the social relations among users, but it also affects the flow of information on the network nodes that form organization structures. For example, the ability to exchange task related information with a wider set of people may result in new relationships forming (Monge and Eisenberg, 1987). On the other hand, extensive adoption of ICT means may be constrained to reinforcing particular patterns of interaction and work practice (Zack and McKenney, 1995).

Behaviors address the freedom to act and influence attitudes on related behaviors such as task performance or decision making (Burt, 1991). At the same time organizational technology may provide far greater ability to locate and create access to resources and views. For example with the use of ICT means participants are enabled to exploit "holes" in a social network by connecting nodes that formerly have not been connected. In such contexts of action a diversity of views may influence the impact or use of the technology in more complex and difficult to manage ways (Zack and McKenney, 1995).

Holes in a social network may be met in the format of interpersonal issues which are not trivial and are likely to lead to tensions –apparent dichotomies between two equally desired capabilities; those tensions if remain unresolved are likely to lead to real discomfort and potentially lowered performance; however those tensions are not always actively discussed. In a research project conducted at a transnational level across European countries Walrave and DeBie (2005) point out that teleworking programmes usually are launched with great attention to work planning, work hours, facilities and technology: all those aspects that managers are legitimised to handle; yet, there is little consideration of social aspects of that type of work concerning the risk of reduced access to company information, social isolation from their work environment, limited information sharing due to the physical separation (Walrave and DeBie, 2005).

There is a clear implication in this research analysis that the speed, interdependence and intangibility of everyone's knowledge in mobile work activities (Davis and Meyer, 1998) impose new demands on our own knowledge capabilities. If remain unmanaged those demands can leave us strategically disadvantaged: *"we are cut off from the dynamics that*

affect our performance on the knowledge landscape of our industry". If they are well balanced "... the tensions give us the ability to use knowledge effectively and respond flexibly in a range of circumstances" (Mckenzie and Winkelen, 2004: 278). The issue of resolving this type of tensions could be related to managerial blindness only or there are certain aspects of mobility that could be further addressed?

In this chapter we are going to examine how knowledge value can be created and sustained in academic work-integrated practices delivered in electronically supported learning environments where participants' mobility prevails; further on we are going to examine how e-learning network participants can resolve the apparent conflicting pulls which are inherent in mobile work and may end being either the strength or the weakness of knowledge generating practices.

4. Challenges of e- learning processes in academic environments

Academic organizations using mobility as a work-integrated learning tool are considered to be a type of paradoxical entities, - where a paradox or dilemma is seen not as an unresolved problem but merely as a dichotomy formed by the tensions inherent in constantly translating fluid and versatile knowledge resources practices into tangible value. Mckenzie and Winkelen, (2004: 278) define paradox as "*an inevitable consequence of organizational existence driven by the need to adapt constantly to changing conditions, whilst remaining in essence a coordinated and coherent vehicle for value generation*".

The versatility of knowledge activities in virtual academic environments presents some conflicting pulls that stretch the mobile learners and tutors in their efforts to fulfill three essential organizational capabilities: competing, deciding and learning (Mckenzie and Winkelen, 2004).

Competing for knowledge creation

In the modern economy once it was recognized that learning faster than competitors would be the only source of future competitive advantage learning became a strategic priority for many organizations (De Geus, 1988). In that scenario it is suggested that an organization's capability of acting intelligently in the face of uncertain conditions comes from setting new strategic aims which are focused on the identification of existing and the formation of new connections that create knowledge flows in an out of the organization (von Krogh and Grand, 2002). From the perspective of knowledge value generation considering that flows have usually a two-way direction two key questions have to be answered:

Inside out: In what ways and to what extent can internal flows of information influence external conditions to the organization's environment?

Outside in: how much knowledge can be reasonably absorbed from the external environment and efficiently integrated into the organization's practices to generate market value?

Von Krogh and Grand (2002) point out that to recognize accept and integrate new knowledge an organization needs to be able to identify the knowledge relevance to its past experience, their current perspectives and their existing resources they have available to allow for further knowledge exploration.

Deciding on knowledge creation

Kalihara (2003) identifies a major issue in the understanding of the relationship between mobile computing and distributed learning from the individual, social and organizational perspectives. Specifically, he points that there is a lack of the desired understanding of how mobile computing shapes a fundamental aspect of our physiological, sociological and psychological abilities – our ability to learn. Kalihara (2003) also points out that the diverse nature of mobility requires some unification to bring clarified understanding in this discourse. The problem of mobility in academic e- learning processes is often situated within the problem of mobility vs stability. Specifically, there is a confrontation between the conceptualization of fluid mobile networks in remote locations versus stable social networks of those distant locations that challenge the purpose of the academic e- learning programme setup. In relation to mobility and stability, monitoring and coordination of the mobile participants and their potential of creating a virtual learning environment is also critical; mobile information services are determined by the individual instructors' fundamental pattern of motion and the necessity to interact with their learners in different contextual environments, while being mobile, with the support of technology (Mckenzie and Winkelen, 2004).

5. Empirical aspect of this study

The Technological Educational Institute of TEI, Halkida, part of the Greek state university system, opened its doors in March 2006, with a goal of offering 25% of the university's courses via distance. The departments of Business, Electrical Engineering Aeronautics and Foreign Languages made the strategic decision to offer its ERASMUS program in both face-to-face and distance formats. In the first iteration of the distance courses, instructors sometimes choose to have both a distance and face-to-face component to their classes (Goldberg, 1996). Since it is now necessary for some students to attend their courses without coming to campus, all required courses, and an adequate number of elective courses, must be available in a 100% distance format.

The on-campus courses are highly interactive and process-oriented, with objectives that focus on preparing the students for global and cross-cultural management. One major anticipated outcome is to move students away from an ethnocentric perspective, through the use of simulations, and experiential exercises to influence changes in attitudes and behaviors. While the on-campus delivery of courses is the most preferable format for behaviorally oriented classes, the implementers of the programme use e-learning approaches to deliver an experientially-based course in the ERASMUS program. The on-

campus courses are highly interactive and process-oriented, with objectives that focus on preparing students for global and cross-cultural management. The face-to-face version of the course focuses on having students examine their cultural values, reinforcing and/or changing behaviors and attitudes, and assisting them in developing cross-cultural competencies. This is accomplished through the use of experiential exercises, modeling of effective behavior, written and video case studies, international negotiation simulations, exchange of cross-cultural experiences and country-specific training modules.

Overview of the Research Methods

The research approach followed in this project is rather exploratory comprised by three phases; initially, *Phase 1* involves a series of *research interviews* with academic staff and students who have participated in e-learning courses; at this stage the main aim is to identify key research issues related to the identification of the spatial, temporal and contextual dimensions of e-learning academic programmes embraced by the TEI. These interviews will also be used to pilot a research/personality questionnaire on students' perceptions about the transformation into the e-mode of the academic curricula and how this is likely to influence their expectations and learning objectives. Hence, this stage is laying the grounds for a larger study, underpinned by a mixture of qualitative and quantitative data which are expected to be gathered in *Phases 2 and 3*.

In *Phase 2*, we'll be studying individual perceptions of academic staff on how technology can influence students and tutors' e-learning experience in developing boundaries and behaviours with regard to three essential organizational capabilities: competing, deciding and learning (Mckenzie and Winkelen, 2004).

Research questions to be answered

From the perspective of knowledge value generation considering that information flows have usually a two-way direction two key questions have to be answered:

- In what ways and to what extent can internal flows of information be generated through the development of e-learning programmes?
- How much knowledge can be reasonably absorbed from the external environment and efficiently integrated into the TEI's practices to generate market value through the establishment of e-learning programmes? Hence
 - How can the new knowledge be related to TEI's past experience?
 - How could current perspectives and their existing resources be best used for further knowledge exploration?

Moreover, in *Phase 2* the possible changes that mobile technologies are likely to introduce in teaching, learning, and research practice will be highlighted with particular focus on the possible success of mobile learning as a dynamic tool that will reinforce the learner's ultimate evolution around a mosaic of rich converged experiences.

Following the constructivist framework, in *Phase 3* of this research project we also include the learner's affective domain—his/her feelings about learning, self-confidence

about learning, and the knowledge of how he/she learns best. Such issues may be addressed in the environment of an e-learning programme through personalization of the programme and positive feedback for the student. Student feelings may be enhanced not only through opportunities for collaboration, but also for autonomy and self-regulated learning (LeBow, 1993). The latter should include error recovery activities that allow reasoning to flow out of a mistake, resulting in a positive feeling of empowerment, rather than the negative feeling that may result when students are simply given a correction with an unjustified judgment (LeBow, 1993). In a constructivist environment, students must be given the encouragement to guess at solutions and the freedom to feel some level of ambiguity about a given topic. These encouragements may be provided within the programme, in the absence of a facilitative instructor. Such support may help learners make intelligent inferences about meaning, increase tolerance for ambiguity, and provide motivation for the learner to take responsibility for his/her own learning.

- How easy or difficult is it for tutors to create their own fundamental patterns of mobility tailored to the needs of different e-learning contexts?
- To what extent are academics aware of the degree of difficulty that students have to cope with in order to adapt and respond positively to the norms and requirements of good collaboration in different e-learning contexts?

Conclusions

The radical advancement of technology emphasized with the arrival of advanced ICT technologies creates a strong anticipation for the oncoming wave of learning innovation. In researching the possible changes that mobile technologies are likely to introduce in teaching, learning, and research practice we anticipate to identify the most vital parameters of successful mobile learning which agreeably demands much more than a rich presentation layer that runs efficiently on a variety of platforms and a variety of form factors. Effective mobile learning programs will require new digital communication skills, new pedagogies, and new practices. Although, new software programs can greatly facilitate and enhance distance education, personal interactions will always be in the center of attention towards the creation of a different e-learning environment. Therefore an understanding of the interaction between information technology and social structure is required to fully understand the impact of organizational technologies and how this can be most effectively exploited towards the generation of new knowledge. As more holistic models based on current theory and practice are developed in addition to traditional, positivist models, wider varieties of learners may then be reached in the e-learning environments.

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Continuously Connected Environment for Collaborative Telework

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Abstract: This chapter describes our current study in the development of collaborative design environment which considers ICT (Information and Communication Technology) and architectural space. Our study group has been developing a computerized prototype environment for collaboration, which attempts to support synchronous design collaboration in a continuously connected project-room at distributing sites. The authors focus on communication in order to evaluate the collaboration environment. The objectives are as below. Objective 1 is that finding problems and its factors of the continuously connected project-rooms in the distributing sites. Objective 2 is that improving the problems of the continuously connected project-rooms in the distributing sites. In the conclusion, we have realized and extracted four major issues towards improving the distributing project-rooms environment in our future study, which is listed in the table with the objective 1. The authors improve the problems of the environment by using appreciation and changing architectural space in the objective 2.

Keywords: Continuously connected, ICT, distributed site, communication, awareness

Introduction

Information and communication technology (ICT) has been rapidly structuring personal work environments between remote sites such as e-mail, mobile phone, and messenger system. And also the authors have focused on collaborative design environment rapidly developed via Internet using web pages or video-conference systems, such as VDS. Some research groups have developed typical systems effectively to access to database of information (Kurmann, 1999), to share process (Jeng, 2000), to support awareness (Mieusset, 2000), to manage project (Morozumi, 1999), to teach architecture (Fowler, 1997; Kvan, 2000). Through our past eleven projects since 1996, the authors have developed several systems for visualization process, accelerate interaction and so on. Such VDS systems mainly focused asynchronous design collaboration via Internet (Virtual space). However these systems do not concern with continuously connected environment

for group work. (Table 1.) Additionally teleconference systems have not yet been enriched with ICT very much, so that most of these consist of just a desk, chairs and video displays. An information infrastructure that has been expanded and improved makes it possible to connect networks continuously. The authors focus on the continuously connected environment enhanced by ICT for group work. In this chapter, we discuss the possibility and effectiveness of a continuously connected environment for group work and point at the issues that need to be improved for collaboration work.

	Group work	Personal work
Continuously connected	We focus on this category	Messenger system
Connected on demand	Tele conference system	E-mail, BBS, Mobile telephone

Table 1. Ways of telework between remote sites

1) The prototype environment

In order to develop the prototype environment supporting effectively for exchanging and sharing information to create idea, the authors have studied the factors of collaborative design work considering ICT and spatiality. (Yamaguchi 1999)

The specifications of the prototype environment (Figure 1. and Figure 2.) are as follows;

- 1) Space frame can be attached and removed easily for various instruments such as projectors, speakers, cameras, microphone, lightings, etc. The space structured by frames that creates a sense of being surrounded.
- 2) Four-multi big screens are on the white board wall, the glass partition and the roll screen, and the glass top table:
 - a. The White board wall that can be used for a wide screen projection. (190inch)
 - b. The Glass partition and the roll screen made by a white permeability film for rear-projection. (110inch) One can write in the glass partition by marker pens.
 - c. The Glass top table on which surface is filmed for underneath projector has a function for drawing like a white board on the projected surface.

There is a central PC which is connected network and controls this environment, and it consists of applications for keyboard-mouse sharing, downward camera controlling, etc. Additionally, in order to support distributed collaboration, this prototype also provides the desktop sharing application, the analog document sharing system with scanner, the scheduler for groups and WebHD which is data storage via internet.

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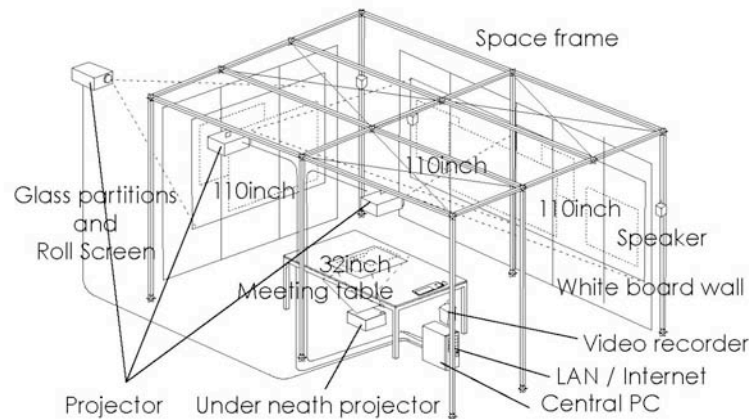


Figure 1. The prototype environment



Figure 2. The appearance of collaboration environment

2) Continuously connected distributed project-rooms

The prototype environment attempts to support not only a face-to-face local meeting but also distributed project-rooms. Although the TV conference systems via network has developed and been used as a common tool at an office or a home, the function of these systems tend to design connecting people to people for a face-to-face meeting of distributing sites, which means people connect the system when they want to have a meeting with distributing people for a certain time. On the other hands, our approach to develop the prototype is to connect space to space continuously. What we expect is that

visualizing other site on a big screen informs a situation and gives an awareness, which may produce communication effectively to collaborate between distributed sites.

In order to understand that the contentiously connected environment affects daily activities, the authors have carried out the experiment in comparing local environment and distributed environment for ten days; first five days is local collaboration and second five days is distributed collaboration. The examinees are six postgraduates engaging in architectural proposal project.

Configurations of collaboration environment are follows:

- a) Distributed environment; three personal desks are in each sites. The main screen connects two distributed project-rooms via TV conference system. The live images at another site are rear-projected on the big screen look like the same room. (Figure. 3) The remote environments are planned as separating the centralized environment and connecting them via tele-conference system with continuously connection, so that the environments have exact same factors as utilizing the collaboration environment and personal area of three members.
- b) Local environment; six personal desks are in the prototype environment. (Figure. 3) The centralized environment is the collaboration room where six personal desks divided by two sides and a meeting table between them is set up.

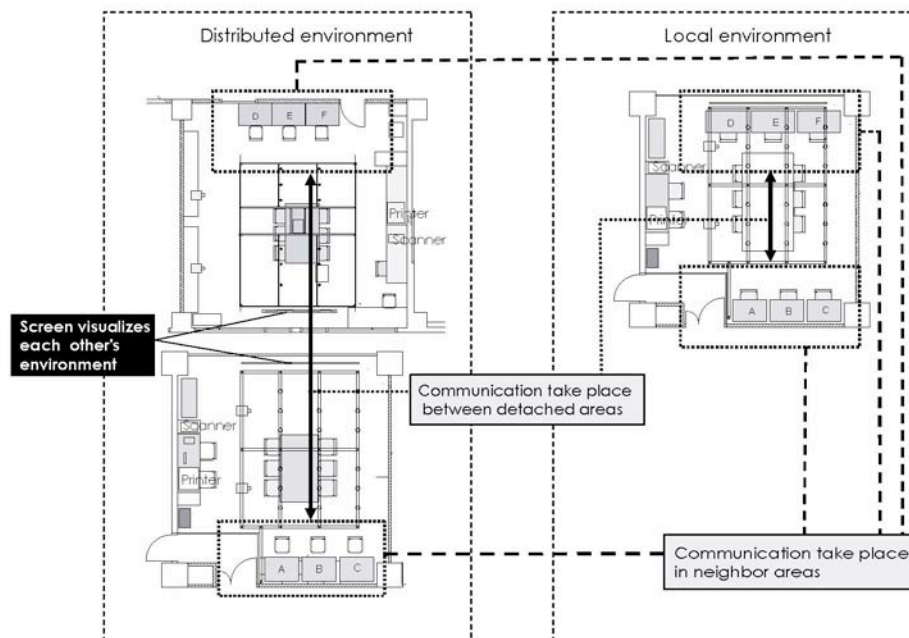


Figure 3. Distributed environment and Local environment

a. Analysis of the contentious connected distributed project-rooms

The communication that is observed from field survey, self-photography survey, and a questionnaire survey are analyzed. Examinee takes a photograph about problems of environment and comment with it in the self-photo survey. This will enable us to understand problems picked out by user about environment.

The authors classify all communications into “Communication take place in neighbour area” and “Communication take place between detached areas” according to the place where communications happened. (Figure. 3)

We pick out three aspects about collaboration based on the researches, and consider the factor. Three aspects are follows:

- The quantity of communication
- The quality of communication
- The place where communication is taken place

The quantity of communication

Comparing local environment and distributed environment, the rate of “communication in detached area” about time and frequency are lower in distributed environment than in local environment. (Figure 4. and Figure 5.)

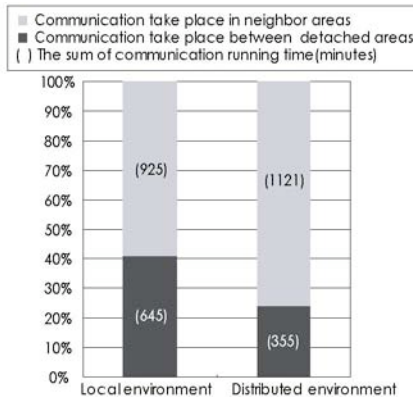


Figure 4. The sum of communication running time

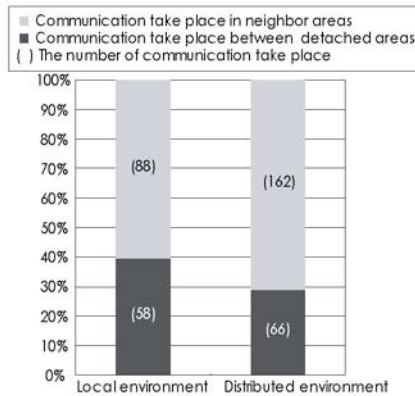


Figure 5. The number of communication take place

So, project members tend to communicate in local site. It is easier to communicate locally. The reasons are as follows:

- The examinees understand the appearance of the distributed member's work. They do not understand the atmosphere of situation and the place. So they fear to talk whether obstruct the distributed member's work progress. Those psychological opinions appear a lot from the questionnaire and the self-photography.
- The sound of local conversation is too low to listen, and the sound breaks due to network problem so that member at other site can not follow the conversation.
- The examinees hesitate to talk excluding a thing necessary for the research activities, because it is difficult to recognize voice by mike and speaker.

The quality of communication

Distributed environment is difficult to support informal communication. (Figure 6.) In distributed environment, communication except research activity was difference between roommate and distributed member. It is difficult to communicate casually. The informal communication is set low priority of conversation.

We guess the reason, pointed out by the self-photography survey and questionnaires, is also Voice recognition and awareness. Members feel possibility to interrupt and disturb the progress at the other site due to less understanding of the context.

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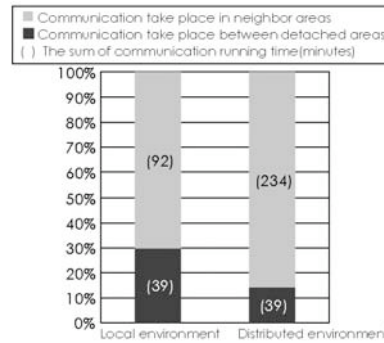


Figure 6. Informal communication

The place where communication is taken place

Communications taken place depend on particular place. Figure 7 shows that communications are done around the table between distributed members. We guess that communication depends on video-conference systems' placement because means for communication is only it.

Additionally, it is pointed out that the conversation excluding around the table are difficult by the self-photography survey. More than two conversation groups cannot communicate in the same screen. The screen which shows other site is the only channel to communicate to distributing members. Member need to move the position where microphone and camera can capture their voice and figure.

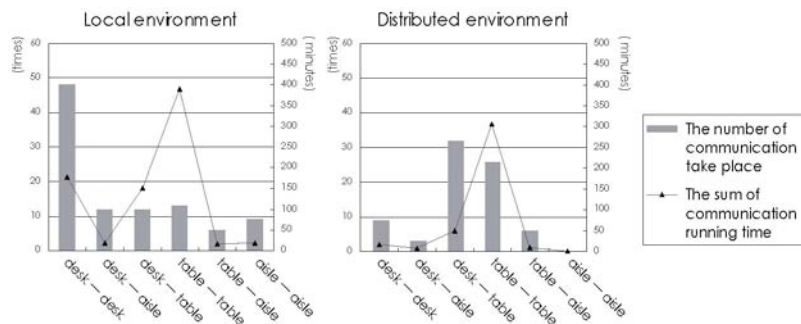


Figure 7. Positional relationship of communication

The results of contentious connected distributed project-rooms

The Effects which contentious connected environment give to communications and their factors we considered are collected as follows

Communication problems between distributing sites	The factors to occur the problems
It is difficult to communicate casually.	The casual communication is set low priority of conversation. Members feel possibility to interrupt and disturb the progress at the other site due to less understanding of the context.
More than two conversation groups cannot communicate in the same screen.	The screen which shows other site is the only channel to communicate to distributing members.
Communication take place depend on particular place.	Member need to move the position where microphone and camera can capture their voice and figure.
Project members tend to communicate in local site.	It is easier to communicate locally. The sound of local conversation is too low to listen, and the sound breaks due to network problem so that member at other site can not follow the conversation.

Table 2. The results of contentious connected distributed project-rooms

3) Reconstruction of the prototype environment

For the sake of compensating the distributed environment's defects that extracted from the preceding experience, the authors modify the environment as below. (Table 3.)

Modifications on the prototype	Aim
Sharing the desktop computer continuously	To increase informal communication take place between detached areas by supporting awareness of operation with PC in distributed environment
Changing layout of personal desks	To increase trigger of communication take place between detached areas by supporting awareness of situation in distributed environment

Table 3. Modifications on the prototype and Aim

The examinees using modified prototype are same members as preceding examination. The communication that is also observed from field survey, self-photography survey, and a questionnaire survey are also analyzed.

Sharing the desktop computer continuously

Comparing to Local environment based on self-photography survey and questionnaire, the informal communication is placed low priority in all conversation at Distributed environment. It is difficult to communicate casually between distributed members.

In order to understand that the sharing the desktop computer continuously make trigger for informal communication between detached members, the authors have proposed and examined to use VNC tool in this environment. We aim to support awareness of the triggers with VNC tool. The VNC is an application that is developed by AT & T Cambridge Institute, which has a function to enable remote members to share the desktop computer. Incidentally, the preceding experiment shared the desktop computer on demand.

The results of sharing the desktop computer continuously

We have compared the ratio of formal communications and informal communications in the continuously connected environment. (Figure 8.) The ratio of the informal communication gets doubled, so that we assume VNC send more information to trigger the informal communications in the continuously connected environment. The communication which is caused with “sharing the desktop computer continuously” is 11% of all communication. “Sharing the desktop computer continuously” supplies the trigger of communication. Additionally, the sum of communication running time gets 29.5% growth, comparing to no using VNC.

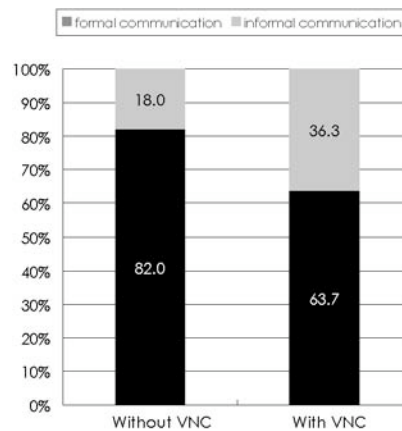


Figure 8. Comparison for informal communications

Figure 9 shows experimental environment's evaluation of awareness on a scale on which 5 is perfection. For comparing, evaluation of original distributed environment points 3rd scale. The experimental evaluation bases on the questionnaire.

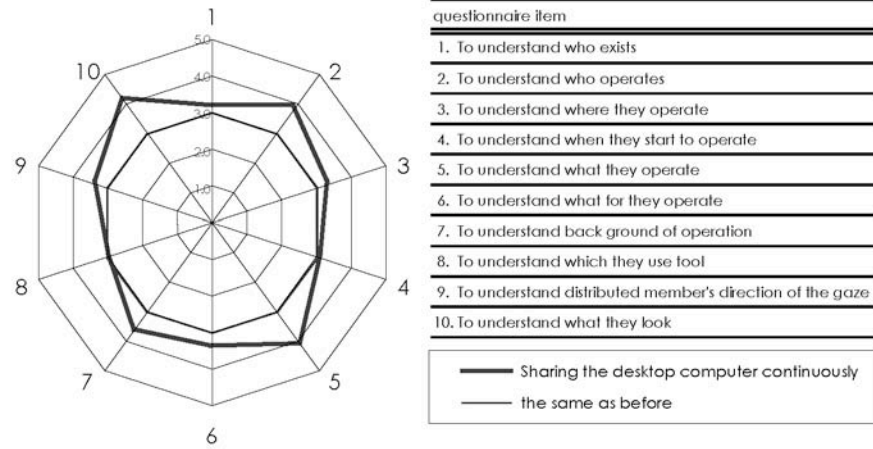


Figure 9. Evaluation of awareness for sharing the desktop computer continuously

Sharing the desktop computer continuously is effective in awareness about understanding member's intent of activity in No.5, No.6 and understanding object which is looked at in No.10.

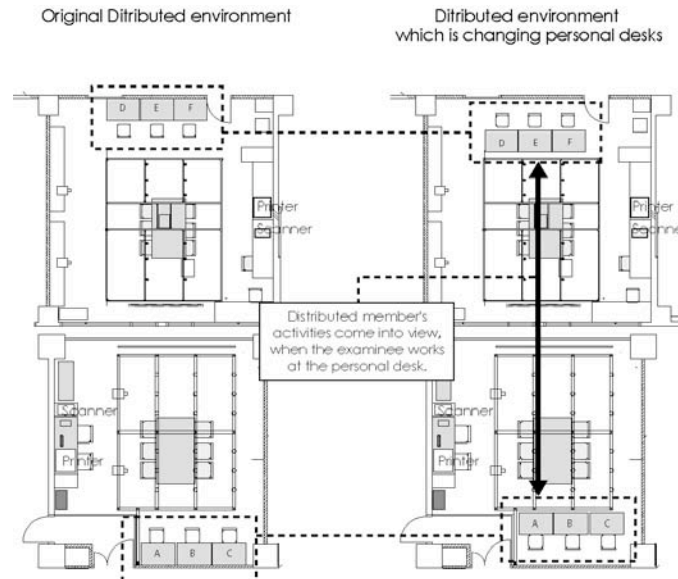


Figure 10. Changing personal desks

Changing personal desks layout

In the first experiment, rather than jumping distributed member's situation to the eye naturally, the examinees identify it as the occasion demands, because examinees show their back to the camera. Therefore the trigger of communication take place in detached area is limited. We modify distributed environment to increase awareness and to take place communication easily by directing personal desks toward screen.

The results of changing personal desks layout

After distributed environment changes, the ratio of communications between detached personal desks get higher. As a result, distributed member's activities come into view, when the examinee works at the personal desk. This is attributed to the fact that it becomes easy to understand distributed member's situation and to take the timing to talk. The times of participation in the middle of communication increase 1.8 times as much as before in environment which is changed personal desk layout. (Figure 11) The authors consider that distributed members become easy to detect “when they begin to speak” and “what story they tell”, and then distributed members understand situations which are conducive to participate in communication.

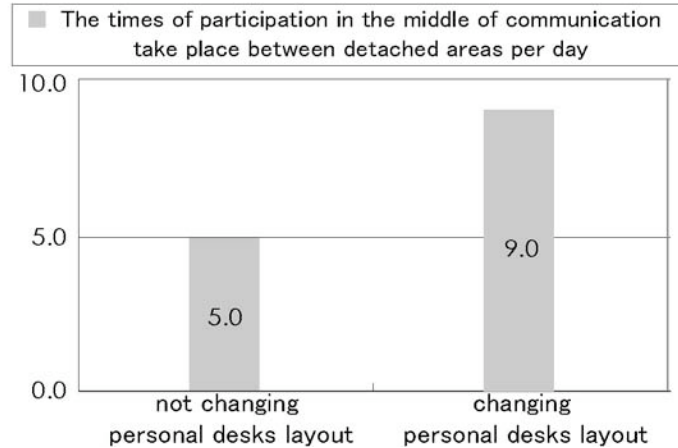


Figure 11. Participation in the middle of communication

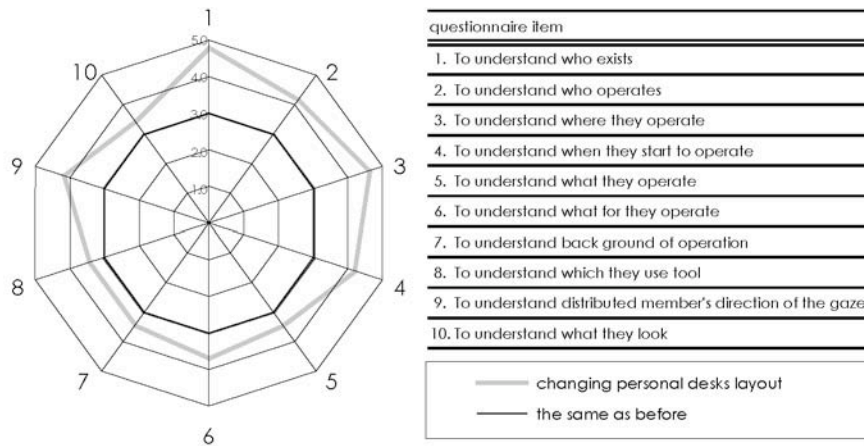


Figure 12. Evaluation of awareness for changing personal desks layout

Figure 12 shows experimental environment's evaluation of awareness. Changing personal desks layout is mainly effective in awareness about understanding member's existence in No.1, No.2, No.3, and No.4. Distributed member's situation and behavior jump to the eye naturally as a result of facing up to screen visualized distributed member's personal work continuously.

Discussion

The authors evaluate the environments of the continuously connected project-rooms at distributing sites in this chapter. Through the self-photography and questionnaire survey, and communication analysis, we extracted four major problems which explain communication barrier between distributed sites, and considered and listed the factors that related to the problems.

The environment is modified in aspects of digital tool and architectural space with being clear to distributed environment's defects and theirs factors. We have improved the situation of taking place communication and awareness in distributed environment. In case of using VNC, sharing the desktop computer continuously as trigger activate communication because it works the awareness of "intention of doing" and "understanding the object".

Changing personal desks layout is mainly effective in "notice the existence of distributed members". It is meaningful to make architectural modification, such as changing personal desks layout without adding any information equipments and applications.

Future studies might consider examining more awareness supporting between distributing sites of continuously connected project-rooms based on the result of this chapter. For example, gaze awareness and directional sound systems. Furthermore, the

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Augmented Reality (AR) interface can be developed considering not only continuously connected project-room but also local meeting environment.

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A Study of Relations between Office Layout and Communications

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Abstract: The aim of this study is to define the indexes to evaluate the activating communications in the office space and to find the relations between office layout and communications. At first, the authors have defined ten evaluation indexes through a research for the office layout trend and a case study. And then, an experiment to compare two different offices was carried out. The authors focus on “quantity” and “diversity” of communications so that the activating communications is evaluated quantitatively. The relations between office layout and communication took place in the office was discussed with the result of the experiment in our conclusion.

Keywords: Office layout, Collaboration, Workplace, Communication, Office survey

Introduction

The substance of the job is unpredictable, and unknown factors must be investigated in knowledge society. It is necessary for new knowledge and abilities to be combined, for collaboration with other fields to increase, and for work to be done while rushing about the city. Information and Communication Technology (ICT) enables people to work at out side of the office space such as at the airport, in a train, in a café; in any city place. In fact, many workers carry out their jobs and communicate with the mobile phones and mobile PC's.

On the other hand, a key requirement for the physical office space is “workplace for groups” in order to maximize the knowledge productivity of a company. The workers select better places in the office to work in accordance with a project phase or their requirements, which is similar that people choose the space to fulfill their object in a city. Consequently, a work-style for office workers has been changing and some new types of physical workplace have been proposed. Non-territorial offices and Satellite offices are some notable examples. Although the communication gets diversity including telecommunications such as e-mails and teleconferences, the conversation in the physical office space get less than before due to distribution of workers. In order to support the group work in office, both formally and informally communications took place in the office need to be promoted.

The aim of this study is to define the indexes to evaluate the activating communication and to find the relations between office layout and communications. The authors focus on “quantity” and “diversity” of communications so that the activating communication is evaluated quantitatively. The ten evaluation indexes are defined as the diversity of communications based on the result of an office layout trend research and a case study. And then the relationship between office layout and the activating communication is discussed through an experiment that compares a common office layout in Japan with an office layout that aims to activate communications.

1. Research for the office layout trend

In order to investigate planning factors of layout for the activating communication, the authors took 131 cases of advanced offices. These 131 cases were collected between 2001 to 2005 from the “Nikkei new Office Award” which was organized by the “New Office Promotion Association” in Japan. There is an evaluation item in the report to the award, which is “a planning for the activating communication in the office space”. The authors collected comments and concepts in this evaluation item from the reported sheets to the “Nikkei New Office Award”. In the result of this survey, the characteristics of planning factors are divided by four levels of office space and listed as table. 1.

The number of cases applied in “the planning for the activating communication” is counted for each level in order to examine the tendency of office layouts. The “layout rate” in Fig. 1 is calculated so that the number of cases applied in “the planning for the activating communication” is divided by the total number of cases in each year. As a result, the layout rate of both the room level and work-station level increased year after year comparing with the rate of floor level and building level. This may indicate the importance of the activating communication on the room level and work-station level due to many open space offices that exist in Japan into consideration.

Space levels	Layout factors
Building level	<ul style="list-style-type: none">- Voids in buildings by which worker can be aware of other floors’ activities.- An atrium where workers communicate casually with professionals out of company.
Floor level	<ul style="list-style-type: none">- Open floor that is able to glance round the office space.
Room level	<ul style="list-style-type: none">- A refresh place is adjoined in a office- Centralized utility space for copy machines, fax machines, stationeries, etc.- A meeting space that is opened casually.
Work-station level	<ul style="list-style-type: none">- Low partitions between desks.- A wide desk that several people can join in.

Table 1. The layout factors to aim the activating communications

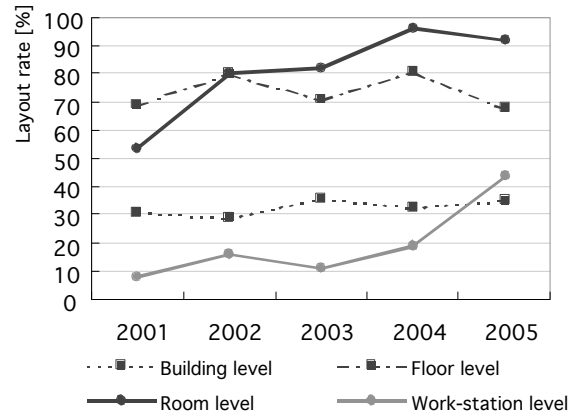


Figure 1. The office layout trend

2. The case study

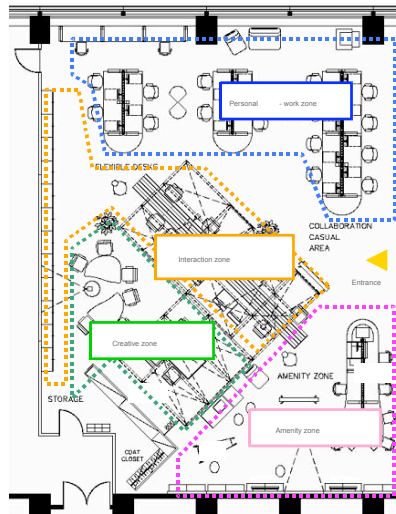


Figure 2. The case study office

Due to the result of the research for the office layout trend, an office which is designed to activate worker's communication with the room level and the workstation level was

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selected to do a case study. The office planned as an office where specialists and professionals from different organizations in a company occupied. The number of workers who own their personal desks and chairs were 19. The area of this office space is 254[m²]. It is shown in Fig. 2 that there were four-zones planned in this office. 1) A personal-work zone where a person works at a personal space on his/her own desk and chair. 2) An interaction zone where there is no function, but a place to activate workers communication. There is a table 9 meters long and two different types of chairs surrounding communication tools such as projectors, white-boards, etc. 3) A creation zone where there is an enhanced meeting room with ICT tools. And 4) An amenity zone for relaxation and refreshment, facilitated with different types of chairs and a table of a different height.

The authors focused on the communication that took place in this office in order to find out the worker's activities that relate to the layout factors. The research at the office was examined for five days (from the 29th of Aug. 2004 to the 3rd of Sept. 2004). A field observation, self-photography research [7], and interview survey were carried out.

Name of evaluation indexes	Short description
1. Exchange between diverse specialists	A worker from other groups comes into the office and communicates each other.
2. Action to write in	Recording the proceeding while meeting take place
3. Meta-discussion	Discussing a project proceeding before a meeting start.
4. Reflect on the meeting	Discussing a result of the meeting after a group-work finish.
5. Information sharing	Using information sharing applications positively.
6. Communications over the territories	Communicating to a worker at far side over the territories and zones.
7. Action to wander in the office	Making approaches to a worker while wandering in the office.
8. Ad hoc communications	Communications occurs incidentally.
9. Join in group-work	A person joins in the middle of a group-work.
10. Migration of group-work	Communications take place in different spaces.
11. A change of pace	Action for a change of pace during work
12. Look over the space	Looking over the neighbours to survey other workers and situation in the office.
13. A casual meeting	Meeting in casual style and place
14. Meeting at many places	Bringing ad hoc communication to a work level as a meeting at any where in office
15. Stumble across upon a clue	Try to grasp a situation to stumble across upon a clue.
16. Break into a conversation	Try to be interested in other workers communication, and cut into their conversation in order to inform his/her idea or opinion.

Table 2. The ten-evaluation indexes

All conversations that took place in this office were observed in a sheet by two observers and also recoded on the video. The conversations were examined with attributions of when, who, and where communication occurred. The contents of a communication tried to be recorded with the interview to the worker whenever the conversation was finished. The communication that examined in the field survey was compared with the result of self-photography research in order to discuss which activities are able to activate worker's communication and what kind of conversations are important to progress their work. The authors have carefully selected the sixteen activities that suppose to evaluate the activation of the communication in the office. (Table. 2)

3. Relations between office layout and communications

3.1 A summary of the experiment

In order to find the relations between the office layout and communication, an experiment was carried out. Two different office layouts; 1. The common office layout plan and 2. The activating communications office layout plan, were set up and compared quantitatively the communication took place in each office space.

The experiment has been carried out for four days with a group of seven examinees include three of the graduated students, one of the forth grade students, and three of the third grade students who belong to the space design laboratory at Kyoto Institute of Technology. The examinees were given a design subject in group work for two days. The experiments have done twice with the different design subjects in the common office layout for the first two days (19th and 20th of Dec. 2005) and in the activating communications office layout for the other two days (26th and 27th of Dec. 2005).

The authors have recorded all conversations took place in these offices during the experiment. In the analysis, the communications are compared between the common office layout and the activating communication office layout quantitatively

3.2 Two office layouts for the experiment.

The characteristics of the two different office layouts ; 1. The common office layout plan and 2. The activating communications office layout plan, are described as below.

The common office layout plan (Fig. 3)

Two functional zones for personal work and group work are planned and divided by a fixed wall temporally in the office space. The 1100[mm] height of partitions are installed between individual desks. A refresh area is prepared at out of the office as same as the office layout plan in Japan.

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The activating communications office layout plan (Fig. 4)

Three functional zones; a personal work zone, a group work zone and a refresh zone, are set up in the activating communication office layout plan. The office is an open office which has no partitions and no walls. A long table to urge examines work in the non-territorial space is prepared in the personal work zone. The utilities such as a printer machine, stationeries, a sofa, and a coffee service are set in the refresh zone. All these are planned based on the factors which is extracted from the office layout trend survey.

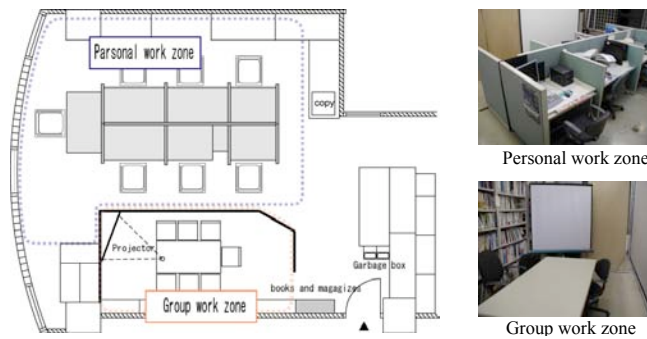


Figure 3. The common office layout plan



Figure 4. The activating communications office layout plan

3.3 Way to count communications

The authors created the data sheets and defined “Communication IDs” and “Communication scenes” as units to count the number of times communication occurred in the office. The definition is listed below.

Communication Ids

The number of conversations was divided by topics of the conversation. For example, both short conversations at the personal work zone and long meetings at the group work zone are counted as one communication ID, because both have one topic for each.

Communication scenes

The number of conversations was separated when either a tool, place or a person was changed. For example, if the conversation starts at a personal desk and then moves to the group work zone to communicate particularly about the same topic, this conversation is counted up to two communication scenes due to the change of place and one communication ID because of the same topic. Additionally, if they used a projector to share their digital information with this topic at the same zone, the communication should be counted as three communication scenes due to the tool used and one communication ID because of the same topic.

3.4 Ten evaluation indexes

The authors selected ten activities (No.1 to No.10 in table. 2) from the sixteen activities in the case study result. The reason we selected it is to simplify the evaluation index and to have the field observation carried out without bothering workers of the examinee. Some of the sixteen activities are necessary to interview workers in order to investigate the contents of the conversation during the examination.

The idea to use these ten activities as an evaluation index is to examine the “diversity” of communication. The number of each ten activities are observed in the field survey and counted with an attribution of the “where it occurred” so that the communication took place in these offices can be evaluated how diversity of communication are involved in each office layout.

3.5 Communications analysis and result

3.5.1 Number of communication

The number of communication was counted by the way of the “communication IDs” and the “communication scenes”. Fig. 5 shows that the number of communication IDs and scenes are in the bar chart, and the total communication running time is in the line chart. All the numbers are the sums of 2days in each layout experiment. Although both the number of the communication IDs and the communication scenes which is counted in the activating communications office layout is about the same as the one counted in the common office layout, the total communication running time in the activating communications office layout is 1.6 times longer than the one in the common office layout.

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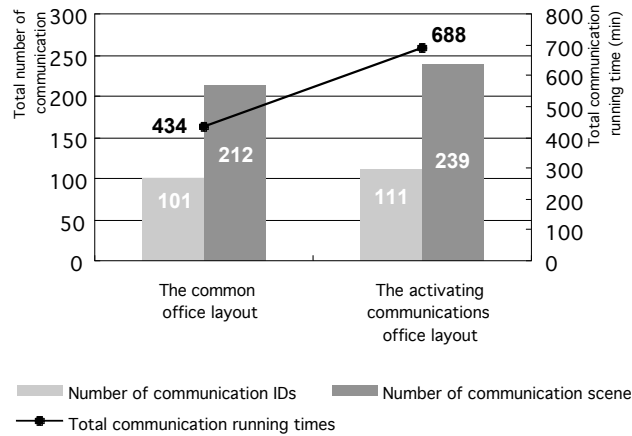


Figure 5. The total number of communication

3.5.2 A characteristic of the communication take place in the activating communications office layout

In order to analyze the result of the difference between the number of communication and the communication running time, the number of communication IDs were divided by a certain time period shown in table 3. The number of communication under five minutes was 87 communication IDs in both the common office layout and the activating communications office layout so that over 80% of the communication IDs are counted in a short conversation such as “greetings to group members”, “asking a quick question to next person”, etc. The authors cut these conversations and compared the conversation continued over 5 minutes (Fig. 6).

	Total number of	under 1 (min)	1 to 5 (min)	5 to 10 (min)	10 to 15 (min)	15 to 30 (min)	30 to 60 (min)	60 to 120 (min)
The common office layout	101	34	53	7	2	1	2	2
The activating communications office layout	111	40	47	5	8	5	4	2

Table 3. The number of communication IDs by the communication running times

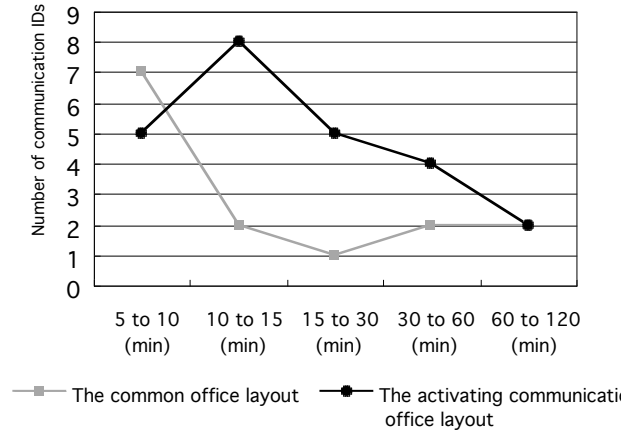


Figure 6. The number of communication IDs over 5 minutes

3.5.3 Ten evaluation index and office layout

Fig. 7 (next page) shows the ratio that the numbers of the communication scenes in each evaluation indexes is divided by the total number of communication took place in each office (Fig. 4). Most of the ratio for the activating communication layout office is higher than the one for the common layout office. Additionally, both No.3 “meta-discussion” and No.7 “action to wander in office” are the activity that is only observed in the activating communication layout office. This may be one of the phenomena that the activating communication layout office diversifies the communication take place in this office.

The personal work zone

The ratio of No. 3 “meta-discussion”, No. 6 “communications over the territories”, No. 7 “action to wander in office”, and No. 10 “migration of group work” observed in the personal zone of the activating communication office layout are over twice higher than the one in the common office layout.

The personal space that has no partition and open to other zones activates the communications took place over the territories, which is the evaluation index of No. 6. Additionally, the authors suspect that the communications that refer to indexes of No. 3 “meta-discussion” and No. 10 “migration of group work” are occurred due to a non-territorial long table where workers meet casually while they are sitting on their own chairs.

The group work zone

The activities of No. 1 “exchange between diverse specialists”, No.3 “meta-discussion”, No.4 “reflect on the meeting”, No.6 “communications over the territories”, No. 7 “action to

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wander in office”, and No. 8 “ad hoc communications” are not seen in the group work zone of the common office layout, which means that these activities are observed as new

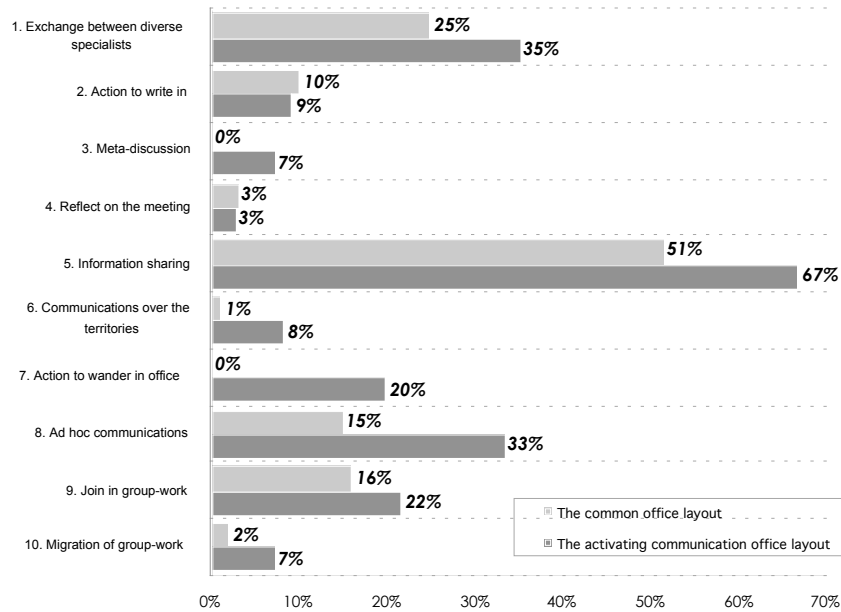


Figure 7. Comparison of the communications ratio

communications took place in the activating communication office layout. This is because of the open office environment and also the zone layout.

In addition, the ratios of No.9 “join in group-work” and No. 10 “migration of group-work” in the activating communication office layout, these are over twice higher than the one in the common office layout.

The refresh zone

The ratio in the refresh zone of the activating communication office layout is compared with the ratio calculated by all communications took place in the common office layout due to the refresh zone of the common office layout is planned and located at outside of the office.

All ratios of No.1 “exchange between diverse specialists”, No.3 “meta-discussion”, No.4 “reflect on the meeting”, No. 8 “ad hoc communications”, and No. 9 “join in group-work” in the activating communications office layout are over 1.5 times higher than the one in the common office layout. The authors suspect that adding the refresh area in the office space can create informal communications which diversify the communications took place in the office such as “communications with diverse specialists” of the index No.1 and “communications took place before and after a meeting” of the index No.3 and No.4.

Discussion

The authors propose a way to evaluate quantitatively the activating communication in the office space. The numbers of communications occurred in the office are counted by the units of the communication IDs and the communication scenes. The ten evaluation indexes are defined through the research of the office layout trend and the case study in order to examine the diversity of communication. Through the experiment set up with the activating communication office layout and the common office layout, the relations between the office layout factors and communications are described with the “quantity” and the “diversity” of communications.

Although the authors discussed the method to evaluate communications quantitatively, the communications should be evaluated qualitatively as well. The communications that contribute to knowledge work will be discussed qualitatively in our future study. In addition, the ten evaluation indexes that have been defined through a case study will be also improved in order to increase its generalities.

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The Telework Introduction Method: the role of Design

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Abstract: The Telework Introduction Method is an instrument to support the implementation of teleworking in organisations. It has been developed based on ICT related-change management and telework literature – combined with experiences during longitudinal case studies. The starting points and content have been applied in real implementation projects, and experiences with the method have been very positive. The study identified and elaborated the content aspects of telework in relation to the implementation process, as well as the integration of an implementation framework with these. The telework content aspects relate to: potential impacts, goals, costs, contingency factors and design options. In this chapter the focus is on the design options and the actual design: what are they, how do they fit in the method, and what evidence is there from the case studies about their role and effectiveness in realising telework implementation successfully. The data confirms that the telework design is an important tool for initiating, steering and supporting the change towards the full integration of teleworking in the organisational routines.

Keywords: Telework, implementation, design, change management, case study

Introduction and background

For decades already, teleworking has been considered to be a potentially very advantageous work method, for organisations, employees and societies alike. However, these benefits can only be realised if teleworking is integrated in the organisational routines in a way that fits the internal and external environment. This chapter looks at a method that aims to help organisations realising this, by supporting the change from being an organisation in which telework is not a regular way of working to full incorporation of telework in the daily routines. Telework is linked to many aspects of work and the organisation of work, such as technology, cooperation, and management (e.g. Steinle 1988, Van der Wielen et al. 1993). Therefore making it work in an organisation is inherently difficult. Although there are already several ‘telework implementation methods’ available, many are simply based on general project- or change management, with some founded on pilot studies and other experiences of one or more companies. This chapter discusses the design aspects of a method for the introduction of telework, called the ‘Telework Implementation Method’

(TIM). The TIM was developed based on a longitudinal research between 1996 and 2001 (see Limburg 2002 for a full account of the study).

Two types of ICT-implementation approaches were used in our study as a basis for the development of a more rigid implementation method: *design-oriented* and *development-oriented* methods. Design-oriented methods set out to analyze the problem in hand and design a blueprint for the desired situation that will be introduced. Development-oriented methods aim to gradually change people's behaviour in the organisation to improve the organisation's performance in general. These are both somewhat simplistic definitions of the approaches, but they reflect their essence sufficiently. Three methods were then used to decide whether telework introduction required a design or a development method (Van Offenbeek 1993, Hardgrave et al. 1999, Boonstra 1992), by comparing characteristics of telework implementation with general criteria provided by these sources. It was concluded that aspects of both approaches were needed. Teleworking inherently involves a design aspect, because it aims for a specific end result and not a general goal such as 'improving the results'. For example, if an organisation wants to reduce risks by introducing telework, there will be certain design requirements in the way employees are distributed. It also needs development because of the changes teleworking requires to the temporal-spatial structure of the organisation (see for example Jackson and Van der Wielen 1995). The consequences of this are hard, if not impossible, to predict, and will gradually evolve. Another important aspect of the required method is the involvement of the future teleworkers and their managers and colleagues, again because of the effects of changing the temporal-spatial structure. A method, or, more accurately, a framework for a method, that was found to incorporate these prerequisites is 'situated design', as formulated by Greenbaum and Kyng (1991). Additionally, ideas from structuration theory (e.g. Orlikowski and Robey 1991) provide a good background for understanding the relationship between design and development, and between created structures and people's actions in organisations.

In this chapter, the resulting Telework Implementation Method will be presented and discussed, focussing on the role of the telework design. After describing the TIM in Section 2, Section 3 will show the results from the application of the TIM for implementing telework at IBM Netherlands, again concentrating on the design element. This is followed by an evaluation of the role of the design element in this case study. Finally, in Section 5, there is a brief discussion of the implications of these results for telework implementation in general.

1) The Telework Implementation Method and the role of design

a. General description of the TIM

The Telework Introduction Method is an instrument to support the implementation of teleworking in organisations. It helps to achieve the change from being an organisation in which telework is not a regular way of working to being an organisation in which teleworking is fully incorporated. The method incorporates implementation phases (process) as well as guidance on telework content. In essence, the TIM is made up of seven

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phases that are based on, and connected through, the so-called ‘situated design intention’ (SD intention). The SD intention is developed from the work of Greenbaum & Kyng (1991) and consists of five principles that prescribe the way of thinking and working in the TIM in general terms. These principles are:

- Principle 1: Start with understanding the use situation
- Principle 2: The telework design should be open to change; it will change the organisation, but will also be changed during use.
- Principle 3: The change process should be based on experience, not just on rules.
- Principle 4: Users are competent practitioners.
- Principle 5: High quality of work is important.








PHASE		INPUT	OUTPUT	PARTICIPATION
Orientation 	S D I N T E N T I O N	Telework Impacts (i1), Telework Goals (i2), Telework Costs (i3), Knowledge and information of participants, Publications	Organisation Specific Goals, Conditions (=o1) Project proposal Awareness	Aimed at broad awareness and key participants. Decision on starting points and constraints. Users indirectly, experts, top management
Information 		o1 + Telework Impacts (i1), Goals (i2), Costs (i3), Contingency Factors (i4), Design Options (i5)	Knowledge about initial situation, more specific goals, indication of design options (=o2)	Aimed at understanding use situation. Users (direct and indirect), line management, experts, departmental managers
Pilot Design 		o1 + o2 + Design Options, Knowledge and information of participants	Design (choice and range of design options)	Aimed at deciding on design. Users (direct and indirect), line management, experts, departmental managers
Pilot Development 		Design	Occurrence of failures, problems, chances and experiences. -Experience with design → -Adaptations to the design Record experiences (=o3)	Aimed at gathering experience with use, improving the design Users experience design and report to experts; experts react upon input from users
Evaluation 		Design + o1 + o2 + o3 Translated into evaluative questions, Knowledge and information of participants	Insights into experiences: -compare with goals -quality of worklife Decision on whether to proceed	Experts gather information from users. Top management forms an opinion about success of teleworking
Definitive Design 		Evaluation results, experiences, o1, o2, o3, pilot design, knowledge and information of participants Procedures for new teleworkers (i6)	Definitive design (decision on choice and range of design options) including specific change procedure(s)	Users (direct & indirect), line-management, experts, departmental managers participate in decisions on design
Development 		Definitive Design, procedures for new groups (i6)	Occurrence of failures, problems, chances and experiences -Experience with design → -Adaptations to the design Record experiences	Users experience design, and report to experts; experts react upon users' input; Workers' repr's and managers monitor process; evaluations after 1 and 2 ys.

Figure 1 The Telework Introduction Method

The seven phases are a result of iterative improvements based on case studies and originate in cooperative prototyping approaches, such as described by Bødker and Grønbæk (1991). In each phase input, output, and participation, are central elements. Some of the inputs (i1-

i6) are included in the TIM, but only the content of i5, design options, is discussed here, as it is the focus of this chapter. A graphical overview of the TIM can be found in Figure 1.

b. The orientation and information phases

Or				
In				
PID _s				
PID _v				
E				
DD _s				
DD _v				

The first phase, orientation, is aimed at translating the general idea of ‘teleworking might be something for us’ into a (project) plan. It starts with somebody’s idea that teleworking could be valuable for the organisation. The orientation phase has two general aims: formulating the goals for the telework implementation (including constraints) and creating awareness within the organisation of the telework potential.

The aim of the information phase is to achieve a thorough understanding of the initial situation insofar as it is related to introducing telework. In the process of building up this understanding, all participants will have to consider the potential impact of the introduction of telework on their particular work situation or function. Based on this understanding, the organisation will study what design options are available, how these interact with the situation (contingencies), and how the combination of situation and design options might lead to realising local and general goals.

c. The pilot phases: design, development and evaluation

Or				
In				
PID _s				
PID _v				
E				
DD _s				
DD _v				

In the pilot *design* phase decisions are made on the shape of the pilot. This involves making choices about the design options (see below). The design process allows the organisation to choose organisation and work design aspects (such as location, management style, etc) that fit the requirements (for example, as in the conference theme, distributing the workforce to mitigate risks). In other words: different situations and goals require different designs. The pilot itself is aimed at gaining knowledge about and experience with teleworking in practice. Even though the evaluation of the pilot might lead to the decision not to introduce teleworking after all, it will be the basis for further introduction if it is decided to go ahead.

At the start of the pilot *development* phase, the pilot design is put into use. Equipment is handed out, rules are declared valid from a certain date, procedures are put into use, etc. During the use of the design all parties involved will experience how the design affects their daily work. The core of the pilot development phase is close monitoring of these experiences and changes by the teleworkers and their direct environment, as well as by the experts (IT, HRM, finance, etc) and supporting departments/functions.

The goal of the *evaluation* phase is to decide whether or not to continue introducing telework, and to provide an overview of the experiences with the pilot in preparation for a possible next phase. The experiences during the pilot should be compared to the goals that were set and be judged on their impact on quality of work life. They also need to be discussed with the participants and workers’ representatives.

d. The 'definitive' phases: design and development

Or				
In				
PiDs				
PiDv				
E				
DDs				
DDv				

In the definitive *design* phase, the experiences with the pilot are used to improve the design. The design of the temporary pilot should be adjusted to a situation of permanent usage. At this stage the project team has experience with designing for teleworking and with the practice of the pilot design. There is also an experienced group of teleworkers and managers available, which makes the process of deciding on what design options to choose quite

different from that in the pilot design stage.

The last phase, the definitive *development* phase, can be very long, since it covers the period from the start of the use of the definitive design until the time teleworking has become so normal and widespread that it is no longer necessary to support the change. At this stage of a project, some people have very specific knowledge and experiences with teleworking, while others have only superficially been confronted with teleworking. Gradually, new groups and/or individuals will start teleworking, and get the chance to experience and learn about telework. Previous experiences have been used to improve the design, and can be used in communication with new teleworkers, but new teleworkers still need to be supported while they gather their own experiences. Part of the development process is ongoing monitoring of these experiences. Fixed dates should be set for detailed evaluations of the contribution of telework to the organisation, and the progress of the continuing introduction process.

e. The Design Options

The design options represent the possibilities an organisation has to shape telework such that it fits the situation and the goals, and at the same time supports learning during the development process. The SD intention prescribes that the design must be tailorable (Trigg and Bødker 1994), meaning that it should be adaptable to local needs and ongoing external changes. The design should have steering capacity so that it helps to realise the goals, and at the same time it must be flexible so it can be adapted to local needs. Six categories of design options are distinguished, which will be described below.

i. Location

The design option 'location' refers to choices made about the physical work environment of the employees. In a broader context this can be seen as the 'organisational ecology':

'the way in which an organisation's leaders choose to convene their employees in space and time in pursuit of a long-term competitive edge' (Becker and Steele 1995: 12-13).

ii. ICT

Information and communication technology plays a central role in most telework designs, and can be found in most telework definitions as an essential defining element (e.g.

Stanworth and Stanworth 1991, Konradt et al 2000, Depickere 1998, Houlihan and McGrath 1998). Unsurprisingly perhaps, Ruppel and Howard (1998) find that the availability of quality communication media positively influences the adoption of telework in organisations. ICT has a two-fold role: it is used to bridge the distance in space and time between teleworkers and their office, colleagues and managers, and also supports individual information work. As telework influences many aspects of creating, sharing and disseminating knowledge in an organisation (Wijayanayake and Higa 1999, Björkegren and Rapp 1999), ICT can also be used to support these processes.

iii. Management

Management is very important for realising teleworking, and also has been blamed for creating barriers for telework implementation. Traditional management methods used in behaviour control systems tend to lose their effectiveness when the distance between manager and worker is increased. Managers respond to these changes by either resisting telework or adapting their control methods (Kurland and Cooper, 2002). This adaptation can go two ways: either there will be more worker autonomy, or managers will introduce more formal, explicit and stringent supervisory procedures to cope with the physical absence of their employees (see Dimitrova, 2003).

The role of any individual manager depends on their personal characteristics, the type of work to be done, preferred management style in the organisation, and characteristics of individual workers. Some authors suggest that management-by-objectives would be the most effective management style in a telework environment (Van der Wielen 1995, Wilkes et al 1994), while others stress the importance of trust (Handy 1995, Jarvenpaa et al 1998). Measures explaining and supporting the changing manager's role should be included in a telework design.

iv. Rules and regulations

Rules and regulations are those design aspects related to procedures, norms, rules, and regulations that are determined centrally in the organisation. These apply to all participants, or include rules on what rules apply to whom. Many aspects of teleworking require deciding upon rules, for example conditions, entitlement, compensations, etc. Due to its temporary nature, the rules for the pilot stage are usually handled differently from the final design. During the pilot there is less possibility to change existing procedures to accommodate teleworking and therefore some things simply cannot be arranged properly. On the other hand, for a pilot, it is often not necessary to comply with all the existing rules; so temporary 'work-arounds' can be installed.

v. Agreements

Agreements are made locally to accommodate specific needs and/or to fill in the framework set by the rules. Agreements can be made for a whole department, group, team, between individual employees, and between managers and employees. It is also important that teleworkers make agreements at home, with the people they share their house with, and possibly also with the broader environment (e.g. neighbours).

vi. Task distribution

It might be necessary to change tasks and/or the distribution of tasks within departments where employees will start teleworking, or in supporting departments. New tasks may be created in administrative support for teleworkers, and often tasks will shift within a group/department, mostly because some tasks are deemed not suitable for doing at home.

2) Case study: IBM

The case study will focus on the design element in the implementation of teleworking at IBM Netherlands, both from a content perspective and its role in the change process. The aim is to demonstrate and evaluate the working of the TIM, concentrating on how the telework design supports the implementation process. After sketching the background and methodology, the pilot design, pilot development, evaluation, definitive design and development phases will be described and discussed.

2.1 Background and methodology

The material for this case study was gathered over a long period of time, mainly from the summer of 1998 until the summer of 2000, with updates on developments and numbers of teleworkers afterwards. The telework introduction at IBM Netherlands took place within a broader framework labelled 'E-place'. Before this, another telework pilot had been executed, with very positive results. The E-place concept was developed in 1998, partly in cooperation with IBM's contracted facilities company. Following the positive results of the earlier pilot, it was decided to study the further possibilities of teleworking.

The data for the case study were collected in two large surveys (baseline and evaluation) and several interviews and most meetings of the project team were attended. The author had the role of supporting the 'soft' side of the introduction process, and to guide the participation of user groups. As much as possible of the TIM has been used prescriptively. All aspects of the TIM have been continuously discussed with the project team and other participants. The utmost care was taken to avoid conflicts between the roles of researcher and consultant during this action research (Kock and Lau 2001, Avison et al 2001).

2.2 The pilot stage: design, development and evaluation

Work on the design started approximately summer 1998. The telework design was put into practice between March and May 1999. Some teleworkers already had some equipment installed before that. The official start of the pilot was declared to be April 1st 1999, and it lasted until November 1999. This was considerably longer than the previous pilot, to lengthen the period for development and thus provide more learning experiences. An evaluation survey was held in October 1999.

2.3 The design

Location

The most important work locations in the design were the office, the home, and clients' offices. Prior to the introduction of teleworking, the office was the main location, although from the information phase it had become clear that already, on average, 30% of the work time was spent working at home, and only 40% at the office. After the introduction of teleworking the home should become the most important work location.

To ensure health and safety of the teleworkers' workplaces at home, they would receive an office chair, a desk, and a cupboard. These were installed for them, whenever possible together with the technical installation, to minimise time wastage. The electrical installation in each of the homes was checked, and adaptations, partly paid by IBM, were made if necessary.

The change in distribution of work among the home, the office, and the clients' locations, as measured in October 1999 (the evaluation survey), is presented in Table 1.

	Average in the baseline survey	Average in the evaluation survey
Number of hours worked at home prior to the introduction of telework.	15.5	12.00
Number of hours worked at home (October 1999).	X	20.8
		=8.8 hours more
Number of hours worked at the office prior to the introduction of telework.	20.5	26
Number of hours worked at the office October 1999.	X	16.4
		=9.6 hours less
Number of hours worked at client's location prior to the introduction of telework.	13.9	11.6
Number of hours worked at client's location October 1999.	X	12.8
		=1.2 hours more
<i>Total (average).</i>	<i>49.9</i>	<i>Prior: 49.6</i> <i>'now': 50.0</i>

Table 1 Comparison between work distribution among locations between the initial situation and the situation in October 1999

A striking result from this comparison is that the respondents exaggerated the difference between the initial situation and the situation with teleworking. In December 1998, they estimated the average amount of time spend working at home to be 15.5 hours, but in hindsight this decreased to 12 hours. Naturally, they also now overestimated the amount of hours they worked at the office prior to teleworking. Most teleworkers were flexible in choosing their location: they did not have agreements on this, and in practice worked in changing patterns. Many teleworkers indicated that they made changes in their routines. The teleworkers became more flexible in the times at which they worked, and could work

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at the times they used to be stuck in traffic jams. The travelling behaviour changed considerably in comparison to the initial situation, although again the teleworkers overestimated the difference teleworking made.

ICT

In all the homes of the teleworkers an ISDN connection was installed on IBM expense. All teleworkers already had mobile computers and mobile phones. Some additional software and hardware had to be installed to be able to use a digital connection. Some older versions of the laptops had to be replaced. To ensure accessibility a system was introduced to connect all incoming calls to the office phone to wherever that person was at that moment.

An electronic 'workroom' was installed on the Intranet where teleworkers were supposed to find all the necessary information on telework equipment and rules. In practice it did not function adequately: it was not maintained properly, many teleworkers did not know about the workroom, and many people could not send questions due to technical problems.

During the pilot development teleworkers thought that there was substantially more opportunity to use 'technical' ways of communication: telephone, e-mail and fax. These media were also used substantially more. The possibilities for face-to-face communication decreased, as did the frequency of this form of communication. There were hardly any changes in the technology itself.

Rules and Regulations

The existing rulebook on working at home, that had also been used in the earlier pilot, formed the general set of rules and regulations for this pilot. An important part of the rules related to entitlements: who could receive which equipment and facilities. Also, the management of the helpdesk insisted on clear procedures for assisting teleworkers, but it appeared to be very complex to design and install these procedures.

During the pilot period no changes were made to the rules. People raising certain issues were referred to the rulebook, in which the relevant procedure was explained. The rules and regulations were not always clear to the employees and managers, although they could get to the right information with some effort.

Management

There were plans to have training sessions for managers of dispersed teams, but these sessions were cancelled. Because it was expected that managers would receive this training there were hardly any other preparations. In the information sessions the managers and their teams were encouraged to discuss the role of the manager in the group, and likely changes due to teleworking. The results of the baseline survey were also communicated to the managers, because they indicated that there was a difference in opinion between the employees and their managers about the managers' roles. Managers thought that the output

of the teleworkers' work was measurable – more than the teleworkers themselves thought -, so problems in that area were not expected.

In practice, the number of contacts between managers and teleworkers decreased, there was less opportunity for face-to-face contacts, and coordination and collaboration became more complex. Although the HR Department acknowledged that telework managers require different skills as compared to managers of office-based workers, they also stated that managers at IBM were supposed to have the qualities needed for managing teleworkers in the first place. A list was made in which the competencies of a telework manager were compared to indicators in the existing Management Development programme. In the future, an MD course, made up of existing modules, was to be offered to E-home managers.

Agreements

Both in the baseline and in the evaluation survey staff were asked about agreements made with colleagues, managers, and family. Table 2 gives an overview of the results.

1=Completely disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Completely agree									
			Average	1	2	3	4	5	N
Base	I have made good agreements about teleworking at home	Teleworker	4.05	1	6	14	21	33	75
Eval.		Teleworker	3.95	1	1	7	18	13	41
Base	I have/ the teleworker has made good agreements about teleworking with my/ her colleagues.	Teleworker	3.28	5	11	29	18	12	75
		Manager	3.60	0	1	0	4	0	5
Eval.		Teleworker	3.38	3	4	14	16	5	42
Base	I have made good agreements about teleworking with my manager/ employee.	Teleworker	3.21	6	9	28	27	5	75
		Manager	3.25	0	1	1	2	0	4
Eval		Teleworker	3.37	4	2	15	15	5	43

Table 2 The quality of the agreements

Agreements at home appeared to have priority, which could be the result of the emphasis given in the information sessions and through the coordinators. Most teleworkers also made agreements with their managers and colleagues. In the information sessions and in conversations with the coordinators it was stressed that it was important to make agreements. On request, some general examples of agreements in other organisations were provided. The taskforce also communicated it was important that all departments would record agreements made, so other departments could use them.

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During the pilot period little changed in whether teleworkers thought they had made good agreements. The home was still the area where most agreements were made, and at work a majority also made good agreements, but a considerable number did not. When asked whether there had been changes in the existing agreements, only eight teleworkers responded, one stating that there were no agreements at all. To provide an impression of the changes in the way people work together within the units (which reflect implicit and / or explicit changes in agreements), an overview of some of the perceived changes is provided in Table 3.

**1= has decreased significantly; 2= has decreased slightly ; 3= has remained unchanged;
4= has increased slightly; 5= has increased significantly**

	Average	1	2	3	4	5	N
The effort it takes to coordinate the work within the unit.	3.33	1	0	26	11	2	40
The effort it takes to work together (within a project).	3.23	0	2	27	9	1	39
The number of contacts with my manager.	2.50	2	17	23	0	0	42
The number of contacts with colleagues.	2.38	2	23	16	1	0	42
The quality of the contact with my manager.	3.07	1	3	30	8	0	42
The quality of the contact with my colleagues.	3.09	2	4	25	10	1	43

Table 3 Changes in work processes

The number of mutual contacts has decreased, with little effect on the quality of the contacts. Coordination and teamwork have become more difficult. When asked directly about changes in the way they worked, the response was often related to better planning.

In a question about negative responses to arriving at or leaving the office at unusual times most teleworkers said there were no negative comments. However, some remarks indicated that the acceptance of teleworking still could be improved:

“Teleworking is not yet accepted well enough. One feels like being a truant when one works at home. That’s why one sometimes goes to the head office, even if it is not really necessary.”

“People outside IBM think you are ill or unemployed when you work at home.”

Task distribution

This design element was not very important at IBM. The most notable issue was the effort put into arranging the helpdesk, because management of the helpdesk very formally insisted on incorporating the task of supporting teleworkers into the existing structure of the helpdesk. The helpdesk was quite prepared for the changes in their tasks, but there were still some remarks about problems with support for solving technical problems.

Apart from the role of ‘telework coordinator’ (taken up by the taskforce leader), the existing tasks, functions, procedures, and structures were used as much as possible, because teleworking was supposed to become the normal way of working. The taskforce leader has functioned as the coordinator for many different aspects of the pilot, to an extent in regular meetings.

Advantages and disadvantages in practice

Table 4 summarises the answers to closed questions on benefits and costs of teleworking in practice. The pilot showed, overall, that teleworking had indeed produced the expected benefits: better fit between workplace and tasks, better working conditions, less stress, less travelling, higher productivity, better matching of private and work lives. These changes did have their downsides though, generally also in line with expectations: less contacts at work, and more effort was needed to realise teamwork and to manage the teleworkers. Some other foreseen disadvantages did not materialise: accessibility did not suffer, and neither did commitment.

From the open questions it appears that the most important gain for the teleworkers was less time spent travelling or in traffic jams. Other items that scored quite well were: better concentration, balancing private life and work, being more productive, and better facilities at home than in the office. As advantages for IBM three items scored well: less costs (travelling, accommodation), higher productivity, and ‘better’ employees (more motivated, less stressed, more efficient).

By far the biggest disadvantage was the reduced contact with colleagues and related aspects, such as missing out on the expertise of colleagues and hearing less news. A disadvantage that proved to be more important than was expected was the inclination to work longer and take no breaks. Another disadvantage mentioned several times was problems with the equipment and facilities, both at home (slow connection) and at the office (worse workplace). Two teleworkers said they saw no disadvantage at all. For IBM they thought the main disadvantage was less control over the teleworkers. Problems with consultations between employees and with managers were also considered important.

Tele-Workplace Design

**1= has decreased significantly; 2= has decreased slightly; 3= has remained unchanged
4= has increased slightly ; 5= has increased significantly**

	Avg	1	2	3	4	5	N
The possibility to coordinate my work and my private life.	4.17	1	1	4	20	16	42
The amount of time I spend with my family.	3.57	1	2	14	22	3	42
The amount of time I work for IBM.	3.88	0	0	13	20	8	41
The amount of non-productive time.	1.90	10	27	4	1	0	42
My own productivity (whole week).	4.07	1	4	0	28	9	42
The productivity of my unit.	3.45	1	2	12	17	1	33
My accessibility for colleagues/manager.	3.14	0	4	29	8	1	42
My accessibility for third parties.	3.29	0	2	28	10	2	42
The satisfaction of my clients.	3.26	0	1	21	9	0	31
My own satisfaction.	4.04	2	1	4	21	14	42
The amount of leisure time.	3.27	2	3	22	10	4	41
The quality of my working conditions.	4.26	0	2	4	17	19	42
My involvement with the unit/ department.	2.86	2	4	34	2	0	42
My sense of commitment to IBM.	3.14	1	5	27	5	4	42
The amount of time I spend travelling.	1.90	13	22	6	0	1	42
The possibilities to adapt my workplace to my duties.	4.02	0	0	7	27	8	42
The level of facilities IBM offers.	3.98	1	1	6	24	10	42
The possibilities to have private social contacts.	3.32	1	1	25	12	2	41
The social contacts with colleagues.	2.56	2	17	19	3	0	41
The amount of stress I experience.	2.63	2	15	21	2	1	41

i. The process: participation, input, output and the situated design intention

Participation

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Decisions about the design were made mainly by the taskforce as a whole, taking into account the comments of the user-representatives. The financial constraints were quite important in decision-making. The results from the baseline survey were taken into account too, as well as the direct input from future teleworkers, for example in the information meetings. Most participants indicate they received sufficient information. The majority of teleworkers stated that teleworking in reality matched the image they had beforehand, which indicates that they were well informed. However, nine teleworkers said that they did not know where they could find answers to questions about teleworking. An overview of who provided valuable information on teleworking can be found in Table 5.

1=none; 2= little; 3=a fair amount; 4=much; 5=very much							
	Average	1	2	3	4	5	N
The E-home coordinator of your unit.	2.85	8	7	11	13	2	41
The project team.	3.00	4	6	18	10	2	42
Your manager.	2.28	12	13	10	2	3	40
Colleagues who already had teleworking experience.	2.77	7	9	10	12	1	39
Papers, magazines, etc.	2.23	14	10	10	5	1	40
IBM-documents.	2.70	4	15	12	9	1	41

Table 4 The amount of useful information about teleworking received from different sources

The plan was that the local E-home coordinator would be the most important source, but the project team was, on average, slightly more important, while the manager had a minor role. The experiences of colleagues could have been used better. IBM documents that contained the rules for teleworking were not much valued as an information source.

During the pilot period, the taskforce had regular meetings in which the experts exchanged information on progress and problems. There were also four discussion sessions with representatives of the user groups. Where necessary and possible action was undertaken in response to issues raised. The teleworkers participated in the evaluation by taking part in the survey and in interviews.

Input and output

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PIDs	Ip	Op	
PIDv	Ip	Op	
E	Ip	Op	
DDs			
DDv			

All the considerations and the information that were collected during the information phase were inputs for the design. The output was the design itself, as well as the awareness of the advantages and disadvantages of the options that had been considered, which of course were in turn inputs for the next phases. The design was partly written down in the Intranet 'workroom', as a source of information about the design for those concerned.

The main input for the development phase was the design, which was gradually introduced between March and May 1999. The knowledge gathered in the information phase was used to discuss possible problem areas with the user groups and with the experts. The general frameworks of the contingency factors, the impacts, the pros and cons, etc., remained important as background for the development, and to trigger people to find solutions to problems. The output of the development phase was the experience of the users and the experts, both tacit and explicit (e.g. documents, survey results).

A major source of input for the evaluation was the survey, and the report made about its results. The questions in the survey were generally the same as in the baseline survey, so the results could be used for comparison with the initial situation. The most important issues in the evaluation report were presented and discussed in the taskforce. The results of the pilot were also discussed with top-management.

Tele-Workplace Design

The SD Intention

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The taskforce had the general premise that decisions on the design should be made in the appropriate part of the organisation (e.g. HR decisions would be made by the HR Department and ICT decisions by the ICT Department). Alternatives were presented and discussed in meetings, and with the user groups when they depended on telework or user specific aspects that could be better judged by the team or the users. A scheme of discussion meetings with the user groups had been developed according to the SD intention. This way the team could monitor and guide how people made the change from the initial situation towards teleworking, and learning experiences could be transferred between groups. A major goal of the evaluation was to collect experiences with the design. These experiences could then be used to improve the design for a large-scale introduction of telework, as well as for advice on the process of introduction, including the support of user groups. The teleworkers saw the introduction of teleworking as a learning process, in which explicit learning by gathering knowledge on experiences and distributing these experiences is important.

Definitive design and development

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The pilot design had generally been satisfactory. The main problems were of a procedural nature rather than content-related. Because there are so many aspects that must run in parallel when converting a group to teleworking (ICT, rules, agreements, support, facilities) it turned out to be difficult to design a procedure that ensured the teleworkers were bothered as little as possible by the physical aspects of the change. The transition now had to be made from a design for a large pilot group to the entire mobile population of IBM.

The definitive development phase started as soon as the definitive design was ready in early 2000. The original pilot group continued to telework, now as the first regular teleworkers. There has not been a general survey into the experiences of the teleworkers during this phase. One of the reasons for this was that there had been some other studies into certain aspects of the design and the experiences with it, which made it both unfeasible and undesirable to burden the employees with yet another survey.

Part 1 <ul style="list-style-type: none">■ Tell member of board which departments are next.■ Present to the director: E-place principles and steps in the transformation (general).■ Present to the department manager: E-place principles, E-place evaluation (procedure) and steps in the transformation (detailed).■ Evaluate with user groups (see part 2: department review).■ Present to, and agree with, user groups → project transfer plan.■ Prepare transformation → project planning and preparation.	Part 2 <ul style="list-style-type: none">■ Department review.■ Function groups.■ Work style indicators.■ Workplace definitions.■ Office, teleworking.■ Capacity matrix (steps provided to establish this).■ Detailed division (office).■ Assignment to Real Estate Department (procedures for delivering equipment, removing and transportation).
Part 3 <ul style="list-style-type: none">■ Transformation to new department → removal and furnishing.■ Evaluation with user groups: survey about experiences, occupation studies, define improvement projects.■ Improvement projects: manage use of E-place, reconfiguration, adjust capacity. Repeat steps 2 and 3.	Evaluation <ul style="list-style-type: none">■ Occupation studies.■ Experiences of inhabitants.■ Out-of-line checks (clean desk, no removal boxes, closets in meeting rooms, drifting mess on closets/under desks, meeting rooms in use as offices).■ Discuss evaluation report with managers and users.■ Conduct improvement projects.■ 'Spring cleaning' (new smell): cleaners remove everything from desks that does not belong there, including personal items.

Textbox 1: procedures for new groups of teleworkers

Major events in the definitive development phase were concentrated around changes in accommodation: a new building was being put into use and other buildings renovated or reorganized. For each transition, i.e. every new group/department, the E-place team developed a general framework of action, which was more or less followed, depending on the circumstances (see Textbox 1). The E-place team monitored some of the developments, concentrating primarily on accommodation issues, such as levels of occupation of office workplaces, and the maintenance of the clean-desk policy. The inhabitants of buildings were also asked for their feedback on experiences, and suggestions for improvements (twice a year).

According to the E-place project leader, the sessions with new groups became very predictable: all the questions and objections had been raised before, but had to be dealt with repeatedly. The changes in the office environment caused more irritation and problems than the working at home component. These continued to be seen as two sides of the same

Tele-Workplace Design

medal: the benefits of working from home were only available to those willing to give up office space.

2.4 The definitive design and development

Location

Because E-place implementation was driving the rollout of the telework design, location was a key issue, primarily because it depended on the location of the office who was entitled to certain equipment and support. Table 7 below describes the three different telework-related work schemes, and who is entitled to each of them.

Table 5 The telework possibilities: hoc, E-hoc, and E-home

Scheme	Who is entitled...	..to what (location related)	How many (summer 2001)
Hoc	Every mobile IBM employee.	Occasional working at home.	294
		Sharing at office: 1:1.	
		No furniture for home provided.	
E-hoc	Part of E-place Certain functions.	Regular working at home.	1479
		Sharing at office: 1:1 – 1:4.	
		No furniture for home provided.	
E-home	Part of E-place Certain functions.	Structural working at home.	684
		Sharing at office: >1:4.	
		Furniture for home provided: desk, chair, cupboard.	

In June 1999 a new building was put into use, which was especially designed and built to support flexible working and the E-place ideas. All other IBM buildings were also planned to be adapted to the E-place way of working, or would be disposed of. E-place included rules on the amount of cupboard space each employee and department is entitled to. These amounted to a decrease compared to the old situation. As with all IBM rulings, additional space could be arranged, provided the department could prove their business required it.

Location was also the main focus of attention during the use and development of the definitive design. From occupation studies and ‘out-of-line’ checks it appeared that people found it hard to live up to the rules for using office space. A clean desk was seldom achieved, the levels of occupation were far below the desired level of 70% (mostly around 40%), managers clung to their own offices, meeting rooms were used as offices, etc. Occasionally firm measures were used to enforce the rules; for example, removing personal items from desks, but usually negative reports were simply discussed with management.

ICT

The E-place design incorporated the way ICT would support each of the types of workplaces. Table 7 describes the ICT aspects of hoc, E-hoc and E-home.

	IBM telephone connection	Telephone provided (all staff have a cellular phone)	Printer/ scanner/ fax
Hoc	Analogue	No	No
E-hoc	ISDN	Yes	No
E-home	ISDN	Yes	Yes

Table 6 ICT provided for the various types of teleworking

A workflow tool to support the administrative process of the distribution of equipment for E-hoc and E-home was introduced. This tool included all the procedures needed, from the first application by an individual for the equipment, through to the collection of the necessary approval(s) of superiors (an applicant needed to have an 'E-place number' to be entitled to anything in the first place), to the delivery and maintenance of the equipment and furniture. The Intranet 'workroom' continued to be used to provide information for current and future teleworkers on procedures, equipment, etc.

The ICT did not appear to be a real issue any longer. The types of equipment in use for the different types of teleworking had become very common. The number of users was very high, so the teleworking equipment and the situation were no longer seen as non-standard to the support organisation. Specific procedures were in place to distribute equipment and to react to problems with the ICT.

Rules and regulations

The main rules have already been discussed in the previous subsections, in so far as they relate to 'who is entitled to what' and 'what procedures need to be followed'. The rulebook was also still applied. Additionally, E-place dictated certain rules, such as a clean-desk policy, about the way the offices should be used, to ensure that the offices were used efficiently and effectively.

The rules and regulations were clearly described and presented as being fixed. As discussed earlier, this was true to the extent that proven business needs could overrule some of the rules. Nearly all departments considered themselves to be unique and therefore insisted on their specific version of E-home. However, this was hardly ever realised, since most arguments could be countered.

Agreements

In meetings with stipulated new E-place departments several issues related to teleworking were discussed, including the need to make agreements. By now, the level of experience of the project members was so high that they indicated that most of the possible problems, as raised in such meetings, were very familiar to them. According to the E-place coordinator:

Tele-Workplace Design

“Every department agrees that we have developed a good design. But each department also stresses that this design does not fully apply to them because they all are, in some sense, unique.”

Because much of this ‘uniqueness’ could be solved in local agreements, there was little reason for making changes to the general rules and regulations for individual departments. The E-place coordinator was also very aware of the general tendency to get as much as possible out of the design, an issue that recurred often in this case study.

Management

E-place received the explicit attention of HRM and was an official issue. There has been a study into the skills managers need for E-place. It was concluded that there are certain aspects of E-place that need specific management skills; however, the managers themselves indicated that they thought it was not necessary to instruct, or support, the managers in the transition period to E-place/E-home. To support the transition, it was advised to use a list of specific elements of managing in an E-place environment, and to discuss this list with the managers.

The E-place coordinator believes that there is a strong relationship between the ability of employees and managers to maintain the E-place policies of function-based, rather than status-based, entitlements and the clean-desk, and the achievement of the sought after ‘High Performance Culture’. Therefore the implications of non-compliance and deficiencies were studied and discussed with the HR manager. Ultimately, a non-complying manager could receive an official warning. Other measures that were considered had a more ‘hardware nature’, such as removing Internet connections from meeting rooms, to prevent managers from claiming meeting rooms as their personal workspace.

Managers found it hard to comply with all the rules in the E-place design, especially concerning the use of office space. Some managers claimed their own dedicated office, often in the departments’ meeting room. This behaviour was seen as unacceptable, but hard to counter. HR conducted a small study into the management style, and found that this has changed hardly compared to how it was before E-place/E-home, although it should have changed. HR aimed to impose stricter rules on the workplaces of managers to force them to change their ways of working.

Task distribution

The E-place team and E-home team remained ‘in office’ until the rollout was complete. The taskforce leader kept his role in coordinating the processes needed to install an E-home workplace. Because teleworking was treated as ‘work as usual’, as many as possible of the existing structures and procedures were used, otherwise new standards were created. Apart from these tasks, no changes in task distribution for the teleworkers and their colleagues were anticipated. Some secretaries and other support staff did experience some changes in their tasks, but this did not lead to real changes in the task distribution.

ii. *The process: participation, input, output and the situated design intention*

Participation

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The definitive design was based on the concepts behind E-place plus the experiences with teleworking gained during the pilot. The participative aspects mainly came from the way employees were involved in making their experiences with teleworking explicit: through their representatives, in meetings, and in the surveys. Together with the experiences of the experts involved this has led to this definitive design. Employees were informed on developments concerning E-place in some internal publications. These described the general ideas, contained some statements by important people and also focused on individuals' experiences with the concepts. The employees were also invited to one or more information meetings, and were encouraged to raise any concerns there.

They were also regularly approached for evaluation purposes, but the response to these surveys was very low. Several experts were involved within their own field of expertise, partly by contributing to informing users, but mainly to 'do their job', e.g. designing and distributing ICT solutions, health and safety issues, etc.

Input and output

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DDs		Ip	Op	
DDv		Ip	Op	

The pilot design and the design of E-place were major inputs. The explicit experiences, recorded in the evaluation reports, were also important inputs. During the previous projects, the several experts involved had also accumulated experiences with the design. The definitive design itself is the output of this phase. Parts of it can be found explicitly in descriptions within the E-place framework, other parts were built into the application that supported the coordinator, and in procedures used by the other parties involved (e.g. user support, ICT).

All the accumulated experiences from the previous teleworking projects were input into the definitive development phase, as was of course the design. The set of implementation procedures applied was also developed based upon the experiences and was used as input. The TIM was seen as one of the inputs for these implementation procedures. The output was an ever-growing population of teleworkers, some with long experience, some newcomers. The results of the regular measurements (mainly on accommodation issues) were outputs, as were the interventions and changes that followed from the results of these measurements.

The SD intention

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The way the SD intention appeared in this phase is a continuation of the previous phases. Although teleworking is seen as a form of ‘business as usual’, considerable procedures are kept in place for guiding the transition for new departments. Each time the initial situation is studied to some extent (to gain a clear picture of the kinds of tasks to be supported) and considerable effort is put into explaining the goals and measures. Every group gets a chance to discuss their objections and fears, and to apply for specific adjustments to the design. In short: teleworking is not seen as just a matter of implementing the design, but as a serious change process, to be based on the initial situation.

2.5 Evaluation of the design element in the IBM case study

A very high level of success in the introduction of telework has been realised in this case, not only considering the number of teleworkers, but also with respect to integration into the business and its contribution to business goals. This was partly due to the fact that teleworking was connected with the relocation and accommodation developments. From the case study evidence and according to feedback from the organisation it is probable that the method as a whole has contributed to the successful introduction of teleworking. Below specific factors related to the design-aspect will be evaluated.

Design Options

The design options adequately covered all aspects of the telework design. Moreover, they provided a very useful framework for analysing the initial situation, and for making and evaluating the design. In relation to tailorability of the design, the design option agreements was very useful, showing that local adjustments could be made, while at the same time requiring these to be made explicit. The design option management proved to be quite problematic. It was clearly an important element in dealing with teleworking, but its implications are far wider. This lead to ongoing discussions with the HR Department and with the managers, both groups accepting that telework implementation required a change in management style, but also being reluctant to make this really concrete. It was tried to use the design option location to influence the management style, by disallowing separate workplaces for managers. This was met with heavy resistance and rules were often ignored.

Tailorability

Any individual or group able to prove a business requiring adjustment of the general design, was entitled to such a change. This method was applied because there was a large element of ‘greed’: most individuals and groups would apply for the maximum version of any design if there were room for it. This method was, therefore, not applied specifically because it was demanded by the method, but it was always used. Other organisations, less

bothered by ‘greedy behaviour’ (e.g. lower budget-orientation) could choose for other options. In such a case, it is likely that it would be more important to make the need for tailorability of the design more explicit, because it would not be a ‘built-in option’. The other way tailorability was achieved, was of a more general nature, namely by seeing the design as a framework, in which local agreements could be used to adjust the design to meet or change individual and group needs.

There are two reasons why a tailorable design contributed to the successful teleworking introduction. Firstly, because it was used to adapt the design to local variations, for example, the use of specific equipment, the need for specific desks, or more support for developing management skills. Secondly, for ‘political’ reasons: as noted, it appeared that every department considered itself to be unique in some way. It was therefore important to show to departments that adjustments to the design were allowed if there was a business need. If this would not be possible, many departments would be less cooperative with the change. Even if, in the end, most departments did have to settle for standard solutions, the possibility of having custom-made versions did make the transition easier.

Interaction Design – Development

The design clearly had an important role in bringing about concrete changes to support the deployment of teleworking. Changing the location and ICT by simultaneously improving the home workplace and minimising the office workplace was important, as well as the supporting rules and regulations. Allowing and stimulating local agreements helped to achieve the necessary level of adjustment to local needs, as well as bridging the ‘learning period’ in which the consequences and needs of teleworking are still being discovered. Agreements are far easier to change than rules and regulations and the other design options. At the same time, the agreements provided a level of stability and clarity needed for groups to be effective.

Conclusions and discussion

The case study showed how the TIM supports the creation of an effective telework design as well as the role of this design in realising the changes in the organisation that are necessary to maximise the benefits for all stakeholders. Much telework literature focuses either on the implementation process, or on design aspects. Here it is shown how important it is to integrate the two. During the implementation process organisational learning takes place, supported and guided by the design (see for example Stein and Vandenbosch 1996). It is essential that the design itself is flexible enough to be adopted as a result of the learning. This reflects the ideas behind situated design as applied in this study, and can also be found in applications of structuration theory:

“...human action can be seen on the one hand to constitute the institutional properties of social systems, yet on the other hand it can be seen to be constituted by institutional properties” (Orlikowski and Robey 1991: 147).

In other words: a design is created (routines, procedures, technology), which is released into the daily work, thus changing the social system. Exposed to this daily work, the design is also changed, for example because something that is at first new will gradually become routine. Stein and Vandenbosch confirm that organisational learning can be seen as a subset of interactions that may be said to contribute to structuration (Stein and Vandenbosch: 118).

For the change process of implementing telework, it is important to realise that the design is a pivot in the learning process. It does not in itself construct the 'new organisation', but guides the change process by introducing concrete changes that provoke experiences and consequent adjustments. The design should therefore have maximum learning value, and communication during the design process and implementation should be aimed at learning from the experiences with the design. During both the design phase and the development process it should be stressed that a design is not the final answer, but an important tool for initiating, steering and supporting the change towards the full integration of teleworking in the organisational routines.

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Design: The Last Frontier.

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Abstract: The world has become truly global. Global, in terms of business but global in terms of people as well. As companies outsource and off-shore their businesses around the world looking for the highest returns on investment, people too are looking for the best ways to invest, in themselves. In a world like this what is the role of the workplace? What are the issues companies need to think about to leverage their human capital in the office?

Introduction

We are witnessing for probably the first time in history a truly global economy or to quote Thomas Friedman: “the world has become flat...globalization got supercharged”. [1] Companies are experiencing competition that is tougher than ever before. Back-offices and call centres are moved to India and the Philippines while R&D centres are set-up up in China and Russia. Companies are off-shoring and outsourcing anything in order to reduce costs, to survive. [2]

The shift in business has a tremendous social impact as well. Gone are the days of a life-long stable career. Look at the job adds in the Financial Times, we are competing with billions of people for fewer positions. We do not climb the corporate ladders anymore, but have to jump on a plane halfway around the globe to grab the next opportunity to secure a job we probably hold for 2 years or so. When companies nor governments are providing a safety net anymore, is it every man and woman in the work force for him or herself? Are we heading towards a “culture of narcissism”, where everyone is “chronically bored, restless in search of instantaneous intimacy – of emotional titillation without involvement and dependence” as Christopher Lasch wrote in 1979? [3]

Furthermore in a world where uncertainty is the new certainty what is the role of the workplace? What should companies with an increasingly fragmented workplace do to leverage their human capital?

In order to be able to grab the meaning of these questions, let alone try to answer them, we need to keep in mind that as companies on the one hand are focusing on hard issues such as cost savings, higher efficiencies, their employees have become almost obsessed with soft issues such as a search of identity and self-realization in anything they do. The gap is widening and the need to address both hard as well as soft issues will be crucial for organizations to not only attract bright employees but also keep their ever-shortening attention span.

1. The rise of individuality

Today's business = knowledge business = people business. Jack Welch once said that most important thing he did at GE was make sure he hired the right people. People are the core of each organization. However getting the best and brightest is not that easy anymore. No longer are salaries alone the main incentives to lure staff.

Let us step outside the office to look and see it all around us: we are living in a me-too society. In the Western world at least there is an increasing emphasis on the individual. Listen to Marc Auge in his influential book *Non-places*: "the individual wants to be a world in himself; he intends to interpret the information delivered to him by himself and for himself." [4]

Funky Business, a book written by two Swedish economics professors who in their leather designer jackets look more like rock stars than academics proclaim: "We can't rely on the Church, the State ...we are all condemned to freedom, we have to take control over our own lives." [5] Taking control means greater responsibility in our choice in anything we do, how we want to live our lives and how we want to work. Choice becomes a tool of expressing ourselves. We are choosing our job like we choose a car, a pair of vintage jeans, a tattoo in order to emphasize our individuality, and in doing so we are showing our alliance to new global tribes. When a 45 year old accountant buys a Harley Davidson, he becomes part of a world-wide family of Harley enthusiasts who share not only a product, but a whole lifestyle associated with it, full of stories and experiences.

Witness the rise of Blogs, Podcasts and the popularity of websites such as Wikipedia and Myspace.com. People everywhere are taking control of their own lives and create their own news. We are not asking the questions to the experts anymore, but we are sharing our thoughts among "normal people". Edelman's recent annual trust barometer report points out that: "Person like yourself or your peer" is seen as the most credible spokesperson about a company and among the top three spokespeople in every country surveyed". [6] Figure 1.



Figure 1: Global players

2. Transition: From the Cell and the City to Sex and the City

The greater emphasis on the individual expresses itself in architecture and global urban planning as well. As early as 1927 the German architect and urban planner Hilberseimer wrote: "The architecture of the large city depends essentially on the solution given to two factors: the elementary cell and the urban organism as a whole. The single room as a constitute element of the habitation will determine the aspect of the habitation, and since the habitations in turn form blocks, the room will become a factor of urban configuration, which is architecture's true goal." [7]

We can see today the shift of space usage in today's global environment towards an increasing emphasis on the singularity of space, the cell, rather than the context of place. Hilberseimer still believed that the cell was part of a greater whole. However, we can see that today's buildings are lost transitional spaces (more on transition in the chapter I wrote in *eBusiness and Workplace Redesign* [8]) that are like islands without any relation to their context. The Dutch architect Rem Koolhaas has described in *Delirious New York* the office buildings in Manhattan as "blocks...alone like an island, fundamentally on its own." [9]

The process of modernization of construction has created a situation in which the context no longer dominates construction. This is only a recent development, Eskimos for example used to build igloos, not because they are so keen on using ice but because there is nothing else to use in their environment. Modernization has changed all this and architects as well as Eskimos are for first time truly completely free to design anything, anywhere in anyway they want. Modern construction materials can be shipped anywhere in the world even to hostile environments such as the artic. [8]

Another example of this transition is Las Vegas where architecture merely exists to grab for the attention of visitors. The construction, the context are all there in support of the activity of gambling, or whatever support activity will take place inside these buildings. Casinos all have the characteristics of transitional spaces: highly individual in design, no relation with the context (the building could basically be anywhere), and orientated towards the interior where the activities will take place 24 hours a day. Are we entering a world with cities where as Gertrude Stein said about California after leaving Paris: “There is no there there”? Will we with this overemphasis on the individuality as well as the spaces we inhabit need to look for what Auge calls “an ethnology of solitude”? [4]

The “there” of the place used to be created by the uniqueness of the context and the materials that came directly from its geographical context, once this is taken away, the here could be anywhere. Moreover context and identity of place are closely related but now that this relationship is gone how does this effect our perception of the place(or places) where we work?

3. A thing about the real

In books such as “The Geography of Nowhere” [10] and “Place and Placelessness” [11] the effects of the process of modernization of construction has been described in great detail. The transitional “anywhere” spaces are ever expanding and creating a world full of places of “most extravagant unreality”. [10]

In a world where the fake, the virtual real and the unreal (secondlife.com, a virtual world with 222,000 alter egos looking for a second, virtual chance to start life again) seem to dominate, there is an opposite trend as well to be looking for real, genuine experiences. In his book “Authenticity: brands, fakes, spin and the lust for real life”, David Boyle takes us around the world looking for Real Food, Real Culture, Real relationships, and Real Politics. Boyle argues that there seems to be a “struggle happening between real and artificial”. Companies need to understand that there is this struggle in the first place and secondly that employees have a “need to lead authentic lives at work” and that this will be crucial “for modern businesses ...to stay profitable...For the first time since the industrial revolution, questions about how we are intended to live – and how we should live – become central again.” He concludes. [12]

Kevin Roberts CEO of Saatchi & Saatchi echoes these words in “Lovemarks” a book on brand loyalty: “People everywhere are wanting to embrace emotion.” Lovemarks are products (or services) that capture new emotional connections with customers. Lovemarks are mysterious, sensual and intimate. [13] Lovemarks are the emotional aspects of the

products that accompany our lives and the relationships we have with these products create meaning in our lives. Naomi Klein has written about this in *No Logo*, the shift of companies from “selling products to brokers of meaning”. [14] This is creating an ambiguous relationship, on the one hand there is a greater need to higher self-expression but on the other hand, people look at brands as a way to express themselves, and in doing so become part of a brand tribe. However, we have extended our circle of friends around the world and we somehow connect through our individual interests and individual choices. Ironically the greater individuality seems to emphasize that people are social beings, and that we all need social interaction be it virtual or real. This explains the popularity of the virtual worlds as well as the growth of real experiences. As 80% of communication is non-verbal, this might rationalize why virtual teams travel half way around the globe for a meeting for no other reason than being face to face instead of communicating solely by email, phone or even video conferencing. Despite the fragmentation of the off-shoring and outsourcing of companies there seems to be an inherent human need to meet in person in order to learn or to create the chemistry to brainstorm.

4. WorkVitamins™ bringing it all together

Joseph Pine and James Gilmore argue in their book *The Experience Economy* that businesses are coming to resemble the experience of theme parks. [15]

The work-life balance demands that we need to re-think the concept of the office. We should get rid of the “one-plus-one offices”, the transitional anonymous islands that float in business districts around the world. The days are counted for the school-type offices where organizations treat their staff as if they did something wrong. Remember the scene in Monty Python’s movie “the meaning of life” where office clerks portrayed as galley slaves revolt against the inhuman conditions they are facing in the office. Boyle again: “Yet unless love and passion are involved somewhere in our working life – whether because the company we work for has real ideas, or because we can be ourselves there – we’re going to lead pretty unbalance lives.” [12]

Thus when we design our work environment it will be crucial to take the emotional aspects of the staff into consideration. Offices should be places that motivate people, places of meaning and experience, places that inspire, where friendships are created and where the staff feels pleasant to be in. If people are looking for genuine experiences, why can’t this be in the office? Or as Ravi Chaturvedi, President of P&G Far East : “Why can’t work be fun?”

Offices that enthuse people are based on a radically different approach: not *where you site* but *how you work* should be emphasized. This means creating work environments that take soft issues such as the emotional aspects of the staff into consideration. I call this approach to the design of workplaces: WorkVitamins™. This is a process where the office becomes a Lovemark, a supplement which emphasizes and supports the needs of the staff in order to do what they can do best.

4.1. People: What are the motivation factors that should improve?

Due to the increasing self-awareness of staff, the branding aspect towards the staff will become absolutely necessary. Motivation will be the key factor to business success, and no doubt about it: the work environment can contribute to the success of a company. Figure 2. We need to address the staff's needs using methodologies that provide us with the necessary elements to investigate and to use in order to create a work environment that provides a basis for the staff to feel psychological as well as socially comfortable in. The work place should be used as a tool to attract and retain staff.

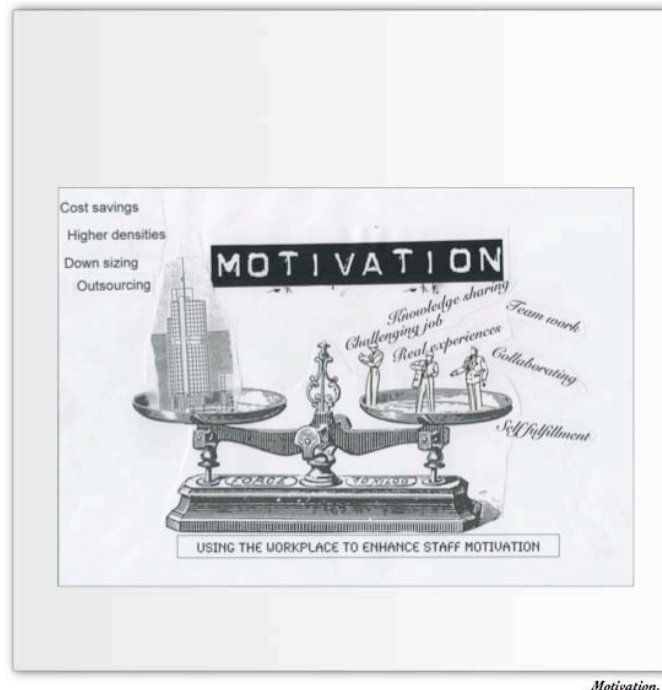


Figure 2: Motivation

4.2 Organization: What are the working styles?

Regardless of the business, each organization will have working styles that can be analyzed and summarized according to the level of interaction and autonomy the various working styles the staff has. [16] Based on the amount of interaction and autonomy levels a worker has, a quadrant with 4 distinct working styles will show that each worker will carry out either individual processing work, individual concentrated study, group processing work or transactional knowledge work. Figure 3.

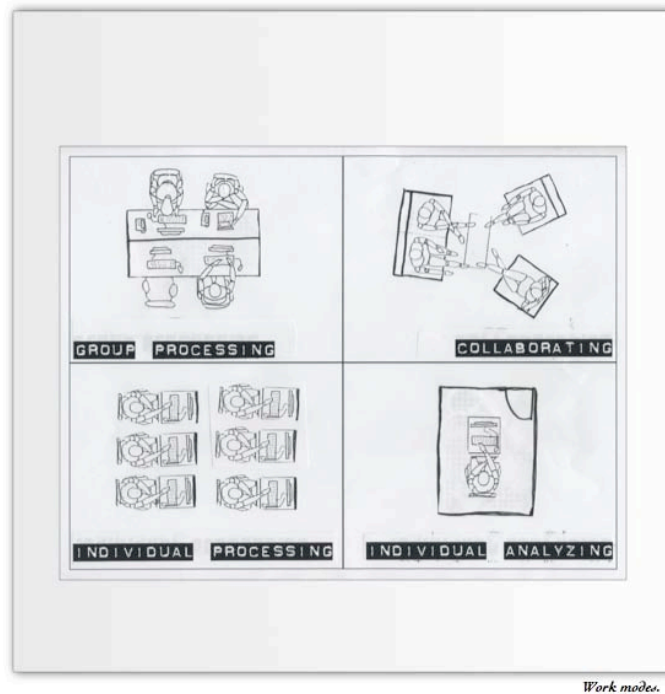


Figure 3: Work modes

Looking closer, due to increasing complexity of the individual jobs, the actual working styles of the various employees will show that most companies have a significant variety in working modes. Moreover, the investigation will show that there will be primary as well as secondary work modes. When an organization steps away from the command and control way of managing their staff, starts to place greater emphasis on the end result of the job, the result should be to stress the work styles rather than the place where the employee has to sit.

This clearly shows that the typical, traditional office environment cannot support the staff's working style(s). Offices need to be flexible enough to support the working modes and needs of the staff. This will mean the creation of a greater variety of working spaces where teams can brainstorm, can make a telephone call that requires confidentiality or require conferencing, reading spaces etc...

As the emphasis will be more on the work mode rather than the physical location of where the work takes place, it will not be necessary to claim a desk as one's own. The dialectic thought thus becomes more towards the idea that the staff "own" the whole office and decide where to work, depending on their shifting needs.

4.3 Technology: How can technology support the needs of the staff?

Ridderstaele and Nordstrom write that most companies “fail to realize that IT is not a core capability...IT is an enabler”. [17] Figure 4.

The shift in the office thus should be towards an IT system that supports team-work with a technology as a tool to accommodate the needs of staff often distributed around the globe working together on projects. For those working inside the same building wireless systems and remote access will truly enlarge the work environment from the whole of the office to areas far beyond the boundaries of the office. Diverse equipment such as the Copy cam, reservation systems, mobile phones, Blackberries and interactive screens are all tools that can support and enable staff to improve communication.

The Copy cam for example can take a picture of a screen and basically functions like a whiteboard. However, the added advantage of a copy cam is that it can be used in combination with a projector. Thus the projector can project an image of, for example a spreadsheet on a special non-reflective glass, while the team can discuss the spreadsheet while writing and correcting on the glass. The copy cam can then be used to document this and send a jpeg image of this to the meeting's attendants.

Reservation system. The lack of meeting areas is quite often one of the main complaints of the staff. A reservation system will make sure that team members can find a space for their brain storming session or teleconference. The reservation system can be integrated with the Copy Cam, thus the images saved will be send automatically to the meeting members as their email addresses have been saved while making the reservation of the room.

Installing a wire-less system will be crucial to enable staff to use the whole of the office as their work environment.



Figure 4: Technology

4.4 Design: the last frontier.

Bob Hayes summarizes the importance of design: “Fifteen years ago, companies competed on price. Today it’s quality. Tomorrow it is design”. [18] Designing an office environment should be a solution to the workplace analysis taking the staff needs, the business organization and the technology into consideration. Thus design will be a creative solution and only then can the office become a truly strategic tool, a WorkVitamin™.

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Telework as a Means To Increase Productivity in Knowledge Work

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Abstract: This article discusses the characteristics of modern knowledge work, and sets the goal of increasing knowledge work productivity. Discussion on how telework is affecting knowledge work productivity is conducted. It turns out that telework, when not mastered in a skilled way, can be a potential source of further productivity decrease in knowledge work. Especially sense for small details, fast decision making and need for social cohesion can suffer.

Introduction

Modern knowledge work, even its most routine form of office work, is an extremely difficult object for productivity measurement. The topic seemed to be in the focus of academic research at the 1990s [1,2,3,4], but is still as important and crucial for organizational success as ever.

The already classics description by Hallowell shows how typical modern office work is being conducted [5,58]:

“...when you are confronted with the sixth decision after the fifth interruption in the midst of a search for the ninth missing piece of information on the day that the third deal has collapsed and the 12th impossible request has blipped unbidden across your computer screen, your brain begins to panic...”

Through telework arrangements any organization becomes more virtual. Typical characteristics of a virtual organization are [6]:

- Mediated interaction
- Geographical dispersion
- Mobility
- Diversity of actors

- Asynchronous work time
- Temporary structure.

Telework has often been presented as a panacea for increasing knowledge work productivity. [7,8,9] This article tries to discuss this issue from the very characteristics of modern knowledge work.

1. The modern office / knowledge work environment

We take the elements listed in Table 1 as characteristics of modern office work as dominant. The list is surely not exhaustive, but should catch the office work reality of today in a reasonably accurate way. We will next shortly discuss each phenomenon mentioned in the table and document its existence and appearance forms. Finally, for each item, we discuss the relationship of telework to the issue.

-
- Fragmentation of time usage
 - Extensive use of e-mail
 - Information overload
 - Communication overload
 - Multi-channel communication
 - Need to see trends and patterns
 - Need to keep up group performance and cohesion
 - Need for fast decision making
-

Table 1 Dominant modern office work characteristics

2. Fragmentation of time usage

Fragmentation of time usage for knowledge workers, especially managers, is a well-known phenomenon. [10] Possibilities to devote reasonably long periods of working time to extensive tasks become scarce. This leads to a situation where small tasks are maybe performed, but it is uneasy to perform large tasks.

Telework is a factor further leading to fragmentation of work. By definition it will fragment work as it comes to place, but as well it is bound to cause fragmentation of time

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usage. However, especially at home it can be easier to cater for longer periods of intensive work.

3. Extensive use of e-mail

Gaudin has in a very compact form defined which are the seven deadly sins that often happen when using eMail [11]:

- Assuming 'Delete' Effectively Erases Email Trail
- Using Company Email for Personal Use
- Not Considering How Email Would Appear in the Media
- Exaggerating, Joking, Boasting and Losing your Temper
- Failing to heed Copyright Laws
- Failing to Double-Check Addresses
- Ignoring Incoming Email that Requires Action.

When performing telework, the worker is usually even more dependent on e-mail than at the traditional office environment, and so the tendency to fall to the sins mentioned above, and also to lower work productivity, is clearly there. It is anyway reason to stress that when applied well the e-mail can be a major productivity tool.

4. Information overload

Information overload is a very well known issue in research on organizational life, and even so in modern daily life [12,13,14]. Butcher has identified several reasons why especially managers and information workers suffer from information overload [15]:

- They collect information to indicate a commitment to rationalism and competence which they believe improves decision-making.
- They receive enormous amounts of unsolicited information.
- They seek more information to check out the information already acquired.
- They need to be able to demonstrate justification of decisions.
- They collect information just in case it may be useful.
- They play safe and get all information possible.
- They like to use information as a currency - not to get left behind colleagues.

One solution to information overload is that of extensive reading: also scanning fast through the information for valuable contents. "One historian has claimed that a "reading

revolution” took place in the later eighteenth century, and the sense of a shift from intensive to extensive reading” [16,179]. A good rule even for the office environment is [16,180]: ”Some books are to be tasted, others to be swallowed, and some few to be chewed and digested.”

Telework can seriously contribute to information overload in one, hopefully most often marginal aspect. When information is placed on non-electronic media, it might be that teleworkers maintain multiple copies of the same media, say paper archives. Maintaining and managing these several redundant information repositories can become a major burden.

As a small special issue, teleworkers might avoid printing documents at their home because of cost reasons. As it is documented that reading from the screen is slower than from paper, telework may so indirectly add to the information overload, as less information can be processed in the same time.

5. Communication overload

In modern office environments a lot of communication happens through “official” channels. In everyday work life, even more demanding can be the task of mastering the informal networks. Cross & al propose six myths about informal networks [17]:

- The more communication, the better.
- Everyone should be connected to everyone.
- We can not do much to aid informal networks.
- How people fit into networks is a matter of personality (which can not be changed).
- Central people who have become bottlenecks should make themselves more accessible.
- I already know what is going on in my network.

The message of Cross & al seems to be more or less that informal networks live their own life, and cannot be managed, but however supported.

Teleworking means that the teleworker is excluded from many informal networks, such as coffee break discussions, and becomes even more reliant on the formal communication channels. This can cause short-term productivity gains, but can too turn into a productivity gap in the long run.

6. Multi-channel communication

A phenomenon making itself visible through increased communication is that of poaching, that can be a major threat for knowledge work productivity. Clemons & Hitt define poaching as involving three components [18]:

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- i. The exchange of information between two parties, as a natural byproduct of contractual exchange for other goods or services, necessary for the performance of contractual obligation.
- ii. The subsequent use of this information by the receiving party, outside the purposes for which the information was provided, and for its own benefit or economic gain, and
- iii. at the expense of, or creating economic damage to, the party that provided the information.

Telework means taking distance to the organization (see also the discussion under the next item). Social contacts to the co-workers get thinner, and so poaching can be more usual.

7. Need to see trends and patterns

Seeing trends and patterns is a key process in mastering the complicated world. "Pattern recognition is the non-trivial process of identifying valid, novel, potentially useful, and ultimately understandable patterns in data" [19].

Teleworking means taking distance from the organization, at least physically, but often also mentally. This distance might mean that he/she becomes an external observer, who might be able to see patterns more clearly. Teleworking also means getting out of the organizational boundaries, and having more communication with the outside world. This might help in trend recognition.

8. Need to keep up group performance and cohesion

An important part of every individual's task in an organization is to boost group performance. Newell et al. call the central activities those of bridging and bonding [20,546]:

"The bridging view sees social capital as a resource inhering in a social network that can be appropriated by a focal actor based on relations with others in the networks. Individuals who provide a "bridge" across divided social communities (structural holes) are important, since they play a brokerage hole."

"The bonding view focuses on the collective relations between a defined group. Social capital relates to the internal structure and relations within a collective."

A difficult phenomenon even in the office environment is that of social loafing [21]:

- Social loafing...describes a person who provides less than maximum possible participation or effort due to motivation and circumstance
- Collaborative technologies can mitigate the impact of social loafing in some ways
- Social loafing represents significant process losses for teams and reduced productivity gains for organizations.

Telework turns communication increasingly to electronic means. So it can weaken bridging and bonding possibilities of individuals. However, at some workplaces these activities are anyway performed through electronic communication channels, in that case telework does not have a decisive effect. Telework gives a lot of room for social loafing.

9. Need for fast decision making

Making fast decisions, and in every possible occasion speeding up organizational processes, is a high business priority nowadays. [22,23] Astonishingly often missing decisions, not just operational time requirements, can be a source of wasted time in processes and elsewhere. Telework can cause slow decision making. Being away from the place where things happen leads easily to the ignorance of sense of urgency. An electronic mail asking for a decision is easily ignored (see too above the section “Extensive use of e-mail”), but when a decision is asked in a face-to-face discussion, and other parties can mediate the importance of the decision through body language, the decision is more likely made in a speedy fashion.

Conclusions

In this article different novel concepts have been presented that have a deep impact on knowledge and office work. The problems of knowledge work can be grouped on having something too much or too little: too much information, work and communication, too little time and social capital.

From the just theoretical discussion it could be concluded that telework is going to make knowledge work even less productive than what normal office work is. The clear advantages might be those of getting more time to perform large tasks, and the new external perspective on the organization, that might lead to better pattern and trend recognition.

Yet most people and organizations that have engaged in telework seem to be happy with the new situation. How can we explain these contradictory results? One solution might be that productivity might not be increasing, but that telework allows more time to be used for active working, and so total output might increase. Telework will eliminate traveling to work and a lot of social contacts, and the time used for these can now be allocated to “real” work. In addition, the total working time may grow in an unnoticed way.

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One conclusion might too be that telework allocates time for real, big, and important tasks, but might leave small details and social contacts without care. If interpreted as telework, it has long been known that artists, when in a productive phase of their work, often withdraw themselves from any social contacts. Actually, this might be telework as its best.

In Table 2, we summarize the effects of telework on knowledge work as found in this article.

The next step would and should be providing empirical evidence to the conclusions made here based on theoretical concept formulation.

-
- Fragmentation of time usage
 - Telework will further fragment time usage. However, home can be a place where longer tasks can be performed in peace
 - Extensive use of e-mail
 - Work gets even more dependent on e-mail, and if e-mail is managed badly, the situation just gets worse
 - Information overload
 - Maintaining redundant archives can add to information overload
 - Communication overload
 - More dependence on official communication channels
 - Cut-off from informal communication channels can add productivity, at least on the short run
 - Multi-channel communication
 - Because of weakening social ties between the co-workers, poaching can become more usual
 - Need to see trends and patterns
 - Teleworking means taking distance and more external communication, both are helpful in seeing patterns and identifying trends
 - Need to keep up group performance and cohesion
 - If the tradition is to bridge and bond the organization through personal methods, telework will decrease social capital. Telework offers ample opportunities for social loafing.
 - Need for fast decision making
 - Telework can slow down decision making because of missing sense of urgency
-

Table 2 Dominant modern office work characteristics and telework effects on them.

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Can New IT Program be a Good Urban Policy for a Municipality? A Case of Loma Linda Community Program, California

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Abstract: In this chapter, Connected Community Program (LLCCP) of the City of Loma Linda, California, was investigated as a case study for the IT infrastructure program by a municipal government. First, the challenge that the city is facing, which is to see the balance between encouraging the growth and preserving the character as a small town, was elucidated. Then, LLCCP's contents as well as its relationships with other plans of higher rank were examined to find out that it has a potential to create economically active highly-dense work/live community, thus to contribute to the smart growth of the city. This study showed the encouraging possibility of IT program both as an urban policy to address challenges of municipality, and as a governmental telework promotion.

Keywords: Urban Policy, Information Technology, Municipal Government, Telework, Work-at-home, Infrastructure

Introduction

In each level of the American governments, telework promotions have been carried out by different agencies/departments independently. While work-at-home by telework could affect housing, economic, environmental, and labor conditions of the society, the corporation between the related agencies/department is rarely seen in promoting telework. This lack of corporation and coordination is especially clear in the Federal promotion, and suggests that it “will not impact the telework expansion in short time of the period” (Kawai & Horita (2005)) [1].

Meanwhile, the implementation of new IT infrastructure has lately attracted much attention from the local governments in the U.S. Examples are the municipal Wi-Fi services by many such as Philadelphia, San Francisco, and Long Beach. Their deployments of IT infrastructure are often meant for the improvement of both technology and economic/environmental condition. For that purpose, municipalities are trying to find ways

to connect their new IT programs with related urban policies such as housing, transportation and land use. If they succeed in this effort, their new IT programs would not only facilitate telework directly, but also create the urban environment which fits and encourages telework, especially the one at home. Then, is it possible that this new IT program, by being more comprehensive, is more effective as a governmental telework promotion than conventional ones?

These emerging municipal IT programs, by being connected to other urban policies, also have possibility to affect the future of environment in suburban and rural towns in America. Many urban scholars, including Mokhtarian (2002) [2], discussed on the urban decentralization under the impact of IT, however, the condition at the possible destinations of this potential decentralization has been neglected so far. The municipal IT program as an urban policy might be a key to understand it.

1. Objective and Method

In this chapter, *Connected Community Program (LLCCP)* of City of Loma Linda, California was investigated as a case study for such a municipal program.

Loma Linda is one of the forty American cities that deployed fiber optics and provide services, and only one city to include fiber optic into its building code. Its service started in September 2004. The objectives of this chapter are;

1. To elucidate characteristics which set the city a part from others, and the challenges it faces as a municipal government.
2. To examine the LLCCP method from urban-planning points of view in an effort to speculate how it could contribute to address the challenges.

For these purposes, LLCCP plan and the related statistics were analyzed as well as regional plans for the city, the county, and the larger region of California. Site visit, in-person interview, and phone interview with the city officials were conducted between November 2005 and May 2006.

2. City of Loma Linda

The City of Loma Linda is located within western San Bernardino County approximately 100 km east of Los Angeles (Figure 1). The following four were examined in the first part of the chapter to clarify the characteristics and challenges of Loma Linda; 1) Social background, 2) Economic condition, 3) Housing condition, and its 4) Financial status as a municipality.

2-1. Social background

The city, small with current population of about 19 thousands, is growing fast. It expects 49% more residents in 30 years (Table 1). This growth rate is higher than that of the larger

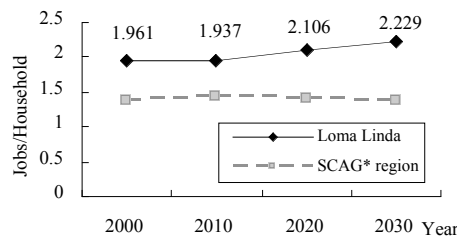
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region surrounding the city (; 39%) which itself is experiencing the growth due to the foreign immigration.

Since its beginning in 1890's, Loma Linda University and Loma Linda University Medical Center have been the center of economic and social activities of the city to this day. This fact is reflected to its demography (Table 2). It has large proportion of residents in the age cohort of 25-44 (university/medical students) and of 65 and order (seniors residing in or around medical facilities). The residents are highly educated with Bachelor's degree (; 34%) and with Master's or higher degree (; 21%). The majority of its household earns more than 95 % of the county median income. More than half of its residents are in management/professional occupations.



Figure 1. Location of Loma Linda



Loma Linda data was calculated by author based on data by SANBAG, 2004. *Southern California Association of Governments

Figure 2. Projected Number of Jobs per Household

Table 1. Population Projection for Loma Linda & SCAG Region

	Loma Linda*	SCAG Region**
2000	18,837	16,500,000
2010	23,648	18,000,000
2020	26,703	19,200,000
2030	28,111	22,900,000
Growth rate in 30 yrs (%)	149	139

*City of Loma Linda Draft General Plan, October 2005

** U.S. Census Bureau data for '00,'10,'20. SCAG, 2004 RTP data for 2030.

Table 2. Socioeconomic Profile of Loma Linda Residents

(unit: %)

	Loma Linda	San Bernardino County		Loma Linda	San Bernardino County
Age*			Income**		
-5	6.2	8.4	(expressed in the ratio to the county median income)		
5-19	18.0	27.2	Up to 50%	21.2	23.0
20-24	8.0	7.1	50-80%	15.8	16.0
25-44	33.2	30.1	80-95%	6.7	22.0
45-64	19.2	18.7	More than 95 %	56.3	39.0
65-	15.4	8.6			
Education*			Occupation*		
Less than high school	11.8	25.8	Management, Professional	55.0	28.1
High school	12.2	25.0	Service	15.3	15.8
Some college	20.6	25.7	Sales & Office	20.2	27.3
Assoc./Bachelor's degree	34.1	18.0	Farm./Fish./ Forestry	0.1	0.5
Grad./Professional Degree	21.2	5.5	Construct./Extract./Maint.	3.2	11.3
			Production, Transportation	6.1	17.0

* U.S. Census Bureau, Census 2000, **SCAG, Regional Housing Needs Assessment 1999

2-2. Economic condition

The same reflection is apparent in the economic condition. Nearly 70% of the jobs located in the city are for health care and social assistance industry (Table 3). The city is rich in job with almost 2 jobs per household (Figure 2), while “1.3 jobs per household is often cited as a balance between jobs and housing” [3]. Jobs in Loma Linda are expected to grow further, especially in medical services, since “due to the developed nature of Southern California, business will be forced to begin locating in outskirt areas such as western San Bernardino County” [3].

2-3. Housing condition

In the regional scale, 2004-5 annual increase rate of housing price in Riverside-San Bernardino-Ontario Metropolitan Statistical Area (; 24.3%) was one of the highest in the country (Table 4). This area also was positioned in the third in the number of single family house building permit. This is because, while the median housing price there (; \$388,900) is affordable only for 20% of residents in Southern California, this is still less expensive than in Los Angeles-Long Beach area where the price is 40% higher.

As of 2006, pre-owned homes in Loma Linda have average price of about \$400,000, and are 10 to 20 years old. There are some communities in about 15 km radius which have similar home prices and profiles of home-owners with Loma Linda including Redlands, Grand Terrace, Highland, and a part of Moreno Valley (Figure 3). The fact that the city is rich in jobs means that it has smaller number of houses than jobs, and that people are presumably commuting to Loma Linda from these surrounding comparable communities. The city does “not believe that Loma Linda needs to compete with surrounding cities for shares of the housing” because of the unique profiles of its residents, however, since “it does not provide enough opportunities for high-end housing, it loses many professionals to Redlands.”[4]

2-4. Financial Status of the Municipal Government

The city’s revenue is increasing steadily and balanced with its expenditure (Figure 4). However, since “a growing population will increase the amount of demand for municipal services” [5], some issues should be addressed.

One is that, while the city “continues to heavily rely on retail sales to fund its general governmental services” [6], with sales tax sharing a quarter of tax revenue (Figure 5), “almost every retail store merchandise category is not well presented in the City” except for “auto dealers and auto supplies” [5]. Another issue is the property tax. The city’s “General Fund property taxes have been increasing over the last seven years, with 13.8% annual increase last year” [6]. However, the “high concentration of property-tax exempt parcels,” including those of the university and hospitals, “limits the amount of property tax the city can expect in the future” [5]. Therefore, the city plans to “facilitate the development of property tax-generating and sales tax-generating uses on many parcels that are now property tax-exempt.”[3]

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Table 3. Number of Employees by industry / Total Jobs

	Health Care & Social Assistance	Retail Trade	Professional, Scientific & Technical	Accommodation & Food Service	Others*
Loma Linda	69.08	3.94	1.40	1.64	23.94
San Bernardino County	16.85	18.35	3.62	11.95	49.23

Calculated by author based on 2002 Economic Census by U.S. Census Bureau. For total jobs for Loma Linda, 2000 data in Job projection list 2004 by SANBAG is applied.

* "Others" include manufacture, whole sale, administrative, support, waste management, and remediation service. They are grouped as "Others" because, while the data for these industries is available for the county, there is no equivalent data for Loma Linda.

Table 4. Housing Condition in Riverside-San Bernardino MSA and Los Angeles-Long Beach MSA

	Median price 2005*	2004-05 increase rate*	Households able to afford median priced home**	Annual Single-Family Building Permits 2004***
Riverside-San Bernardino	\$388,900	24.30%	20%	43,070 (3rd largest out of 173 MSAs)
Los Angeles-Long Beach	\$553,200	22.30%	12%	11,960

* National Association of Realtors 2005 ** SCAG, "Where Will Our Children Live?", 2006

***National Association of Home Builders 2004

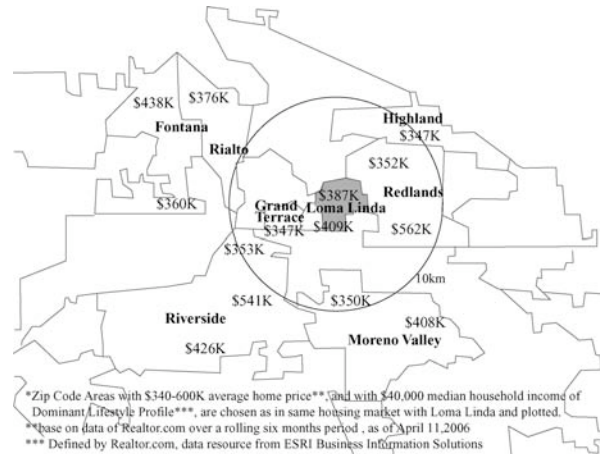
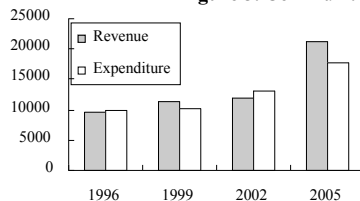


Figure 3. Communities in the Same Housing Market* with Loma Linda



Resource: City of Loma Linda, "Comprehensive Annual Financial Report", June 30, 2005

Figure 4. Revenue and Expenditure of Loma Linda

Property Tax	Sales & Use Tax	Other Tax & Assessments	Licenses & Permits	Inter-Government	Charges for Services	Other
20.86	12.23	17.20	5.35	12.37	13.09	7.28
Fines & Forfeiture of Money				Development Contributions, 6.54		
0.69				& Property, 4.40		

Resource: City of Loma Linda, "Comprehensive Annual Financial Report", June 30, 2005

Figure 5. General Governmental Revenues by Source, City of Loma Linda

2-5. Characteristics of and Challenges for Loma Linda

Loma Linda is small and has an established university and hospital as its economic and social cores. Its residents are highly-educated professionals with good income. Jobs in medical-related services are abundance, and its economy is stable. Loma Linda is a relatively self-sufficient and affluent small town.

Yet at the same time, since Loma Linda is at the periphery of metropolitan Los Angeles, it is experiencing rapid increase of the population, boiling housing prices, many housing developments, and overflow of the businesses from LA. In this sense, Loma Linda is also “a growing suburban city on expanding metropolitan fringe” as many cities are around Phoenix, AZ, or Washington D.C.

These incompatible characteristics of the city are the cause of the challenge that Loma Linda faces. Currently, “the residents are resisting to the growth (of the city)”. However, it is inevitable in the midst of the rapid population growth of the region, and the municipal government has to see what the city need “to be economically viable, be able to provide the quality services to support the community.” The challenge is “to see the balance” between encouraging economic and physical growth and preserving the character through the planning. [7]

3. Examination of LLCCP

In this section of the chapter, strategies taken in LLCCP were analyzed to show how they could contribute to address the challenges. Examination is done from the three levels; i.e. LLCCP itself, its relationship with General Plan of the city, and its link to other plans of higher rank.

3-1. LLCCP

LLCCP was documented in 2003 and started its service in September 2004. It is carried out by Department of Information Systems under the city manager [8]. LLCCP is unique in following four policies. (Table 5)

- a) It ensures the fast and secure connection by the followings;
 - Introducing fiber optic which, even with 5Mbit, is 3 times fast as DSL, and twice fast as Cable.
 - Choosing Active Optical Network which is symmetrical; i.e. same speed for uploading and downloading
 - Deploying 4 circular backbones underground which are self-healing, and distributed machine rooms through the city
- b) It intends to cover the whole city including new housing developments, apartments for the students, commercial buildings, and existing neighbourhoods¹
- c) It is positioned as a public infrastructure by;
 - Mandating to the developers to construct and deed it to the city
 - Maintaining the system by the city

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- Integrating its payment system with other municipal services such as water, sewer and garbage collection
- d) Its technical specification is set in the municipal ordinance (i.e. building code).
 - Data box in master bedroom and an outlet in each room

With these unique policies, LLCCP has a possibility to make two major accomplishments. First, because of its fast and secure access, as well as the complete coverage of the city area, LLCCP was designed to encourage work-at-home and small business among both existing and prospective residents. The fast steady access, combined with all-across-the-city policy of LLCCP, will facilitate doing business at homes and small offices in the city. Second, LLCCP's complete coverage of the city, its position as a public infrastructure, and its technical standard maintained by the city's ordinance standardizes and ensures the better amenity in its area than in adjacent cities. It will also help lifting and maintaining the property values inside the city.

Table 5. Loma Linda Connected Community Program Outline

Network Architecture	Active
Cable System	Category 6, copper-structured cabling system
Year Started	Documented in Dec. 2003, Service Started in Sept. 2004
Area/residences with Mandate Implementation	- Within each residence of any and all new residential development - Additions exceeding 50% of the original structure within Fiber Optic Master Plan Area
What the City Built	4 self healing metropolitan fiber rings under the streets, Network Operation Center
What the City Offers to Developers	Fiber design, Scope of work, Bill of materials, List of approved contractors
What the Developers Build	Developers are mandated to build the followings and deed them(except for the system - Community MDF (3 by 3 meter, dedicated room) - Data Cabinet in master bedroom of each residence - Fiber from Fiber ring into MDF and Data Cabinets - An Outlet with jacks for Data/IPTV, Data/Phone, and Coax/TV/Satellite in each room
Service Provider	Currently the city. However it is open to any provider which follows the city's system and provides voice, video, and data.
Services	- High-speed Internet Service in 5, 10, 15 Mbit/s for residences. Max speed 1 Gps. - Colocation service for businesses. - E-mail services. Future services include web-hosting, TV, and Telephone.

Resource: City of Loma Linda "Ordinance No. 629",
City of Loma Linda "The City of Loma Linda Connected Community Program and Design, Installation and Product Specification", August 2005,
James Hettrick "City of Loma Linda Connected Community Program, Fiber It's What You Need for Speed"

3-2. General Plan and LLCCP

General Plan is "the city's most important statement regarding its ultimate physical, economic, and culture," and "a legally binding policy document" to guide the related decisions [3]. The city is currently making a series of draft for the next General Plan. LLCCP and General Plan of the city are closely connected both in the designing process and contents of the plans.

a) Collaboration in the process of creating and carrying the plans

In making LLCCP, current master plans in General Plan are used as a base. LLCCP is also designed to fit to the future development plan as well as retro-fit to the existing developments.

In carrying out LLCCP, Department of Information Systems which is in charge of LLCCP creates specification and does inspections, while Department of Community Development which is in charge of General Plan tries to reflect the specifications to the actual developments. When a new development starts, a pre-development conference is summoned to deliver plans and ordinances of the city to the developer. Its participants include Dept. of Information Systems, Dept. of Community Development, and other related departments [7][8].

b) Coherence and Coordination between the plans

Since General Plan is the legal guide to the related policies, it is by definition that LLCCP should be coherent with General Plan. Yet in the case of Loma Linda, the relationship between the two plans seems to go beyond that mandatory coherence. General Plan often tries to take advantage of and to help the success of LLCCP, in an effort to bring its own visions into reality. Two of the key-words of its vision, to which LLCCP will be concerned, are 'technology advancement' and 'work/live community'.

In the coming draft² of General Plan, information technology, LLCCP as its core, will be highly incorporated. The city's strategy on information technology is to free its residents and businesses from "worrying about lower layer of IT's OSI model" such as connection and speed, so that they can "focus on application level." The city wants "the entire city to be technologically advanced." [7]

This advancement of technology is supposed to bring small and/or home business into the otherwise residential areas of the city, which is the largest motivation for the city to start LLCCP [8]. Followings are some of the coordination between the two plans, which are found in the recent draft of General Plan [3], to make the city work/live community.

- General Plan has Special Planning Areas in which new mixed-use developments (i.e. residential and other uses) are intended (Figure 6). Construction phasing of LLCCP's four circular backbones (Figure 7) is scheduled in a way to include largest Special Planning Areas (D,E) in earlier phases.
- In residential zoning districts of the city, various kinds of home occupation are permitted, which is a rare case in the U.S. [9]. Self-employed home-workers are asked for land-use permit and business permit, while employed telecommuters are not. [7]
- To attract business in the area, the city is to work with private sectors to identify advanced infrastructure technology. This effort includes encouraging the businesses to do the sale through the collocation service of LLCCP and physically move to Loma Linda to take advantage of LLCCP. [7]
- The city is to promote the establishment of work place alternatives, including home occupations and telecommuting. This will be done through LLCCP. For

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example, the city encourages the Medical Center, which is lacking office spaces, to allow the employees to work-at-home which is possible through LLCCP. [7]

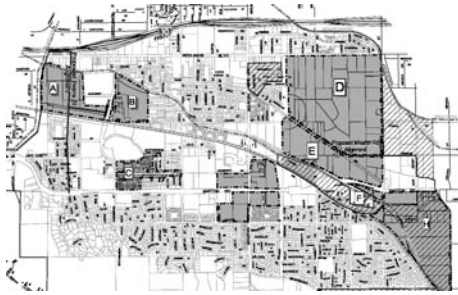


Figure 6. Special Planning Areas in General Plan of Loma Linda (Oct. 2005 Draft)

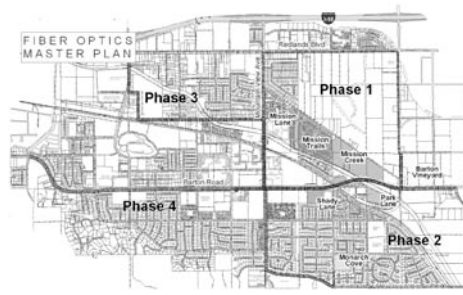


Figure 7. Phasing Map of LLCCP

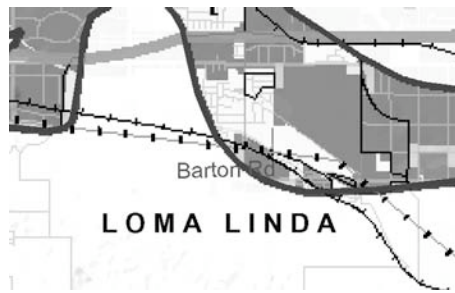


Figure 8. “the 2% Strategy” Area in Loma Linda designated by COMPASS

3-3. LLCCP in the light of Regional Plan

City of Loma Linda, in creating General Plan and LLCCP, not only follows the requirement set by the plans of higher rank, but also goes beyond the surrounding communities by introducing the concept of work/live community to control the problem of inevitable growth.

In the State of California, the implementation of General Plan is mandated to municipalities by the State law (; Governmental Code 65302). Economic portion of a General Plan must be consistent with the plan by Department of Economic and Community Development of the County. Physical and environmental portion of General Plan for each municipality should be coherent with regional plans, such as transportation, environmental, and housing plans, which are set by a regional government (Figure 9). In the case of Loma Linda, that regional government is Southern California Association of Government (SCAG). SCAG encompasses six counties including Los Angeles and San Bernardino Counties, and functions as Metropolitan Planning Organization³. Due to its rapid increase

of the population (Table 1), one of the focuses of SCAG's regional planning is growth control.

It started a growth visioning process called COMPASS in 2003 which “found common ground in a preferred vision for growth” and “incorporated it into immediate housing allocation and transportation planning decisions.” [10] One of the plans which were evolved from COMPASS is ‘the 2% strategy’. Its idea is that, by concentrating growth in just 2% of the SCAG region, the rest can be spared from the negative effects of uncontrolled growth, such as traffic gridlock, air pollution, and housing market crisis. It expects to add 5 million people and over 2 million housing in the 2% area over the next 25 years [11]. Accordingly, many municipalities under SCAG are asked to accept the growing population by building the number of houses which are set by Housing Element Compliance issued by SCAG [12].

Loma Linda is one of these municipalities which have some ‘the 2% strategy’ area inside the city boundary (Figure 8). It was also asked by SCAG's Housing Element to build 1,512 housing units between 1998 and 2005 [12].

Under this rapid growth of the region as well as the requirement by the regional plans, the city of Loma Linda considers that “work/live concept”, which is intended both in General Plan and LLCCP, “is outgrowth of the need to control the problems” of the rapid growth. This is “the direction that the city has to go”, even though “there are not many communities in this area that implemented this concept yet”. The “land-efficient developments” are necessary. In order to control the private developers in this growth, the city “provides platform that can integrate different types of houses”, through General Plan and LLCCP. [7]

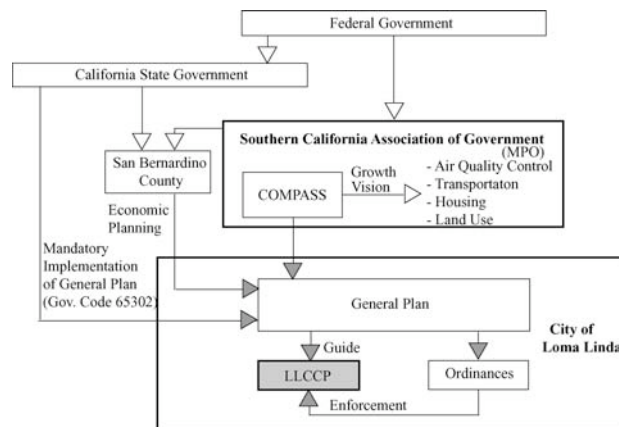


Figure 9. LLCCP and Related Plans

4. Very Good for Loma Linda, yet Good for Everybody?

Figure 10 summarizes what effects LLCCP itself as well as its relationship with the plans of higher rank are designed to bring into the city.

The fast and secure connectivity of LLCCP, along with the fact that it encompasses the whole city, would accelerate small/home businesses. This will also broaden the kinds of industry in which the city's businesses are engaged, and could intensify the economic activity. Sales tax revenue of the municipal government may increase and become stable accordingly.

LLCCP's complete coverage of the city, its position as a public infrastructure, and its technical standard maintained by the city's ordinance ensures high-standard of amenity of residents' lives. This would result into the higher residential property values in the city. According to the data by the trade association of fiber optics, a house with fiber optics is priced \$4,000 to 15,000 higher than an equivalent one without it [13]. This would eventually lead to the increased property tax revenue for the city.

Higher value of the residential property would attract people with high education and income to the city. This, although may not be politically correct, will be a positive phenomenon for the majority of current residents who do not desire the rapid change of the city's profile. It will also make a good market base for the high-end houses which the city is currently wanting. The increasing expenditure of the city caused by the growth would be covered by the above mentioned increased sales and property tax revenues.

LLCCP is not an isolated IT program in the city. It is coordinated closely both in the implementation process and in the contents with General Plan. It is an urban policy which is linked with transportation, housing, and environmental plan. This comprehensiveness of LLCCP could elevate the possibility of 'technology-advanced work/live community' that the city envisions.

Loma Linda's General Plan and LLCCP do not only go along with the growth control vision; i.e. high-density development, of the regional plan by SCAG. They also hold its own concept of work/live community. Mixed-use development will be carried out, which will create highly-dense environment that could accept the population growth. General Plan and LLCCP make a platform for this development, which will prevent the random private development under the pressure of the growth.

As discussed in the Section 2 of this chapter, Loma Linda is a self-sufficient small town with a university and a hospital as its economic/social cores and with highly-educated professionals as residents. Located in Southern California whose population is rapidly growing, the challenge for the city is to see the balance between encouraging growth and preserving the character.

As shown in the above, LLCCP could encourage small/home businesses, create work/live community, and increase the residential property values. Since these mean growth and preservation of the character, it is possible that LLCCP contributes much to the city in finding answers to the current challenge. As an urban policy for the smart growth of a city, LLCCP's prospect should be highly evaluated.

At the same time, the fact that LLCCP, for its comprehensiveness, could be successful in making work/live community suggests a new alternative for governmental telework

promotion. In stead of promoting telework itself in conventional ways, we could be able to increase teleworkers by developing both digital and physical environments which fit for telework. The prospect of the success will be higher, if we plan not only the immediate environment of home-offices or homes, but also larger environment of town and region, as in the case of Loma Linda.

This study, although with only one example in early stage of the development, showed the encouraging possibility of IT program both as an urban policy to address challenges of municipality, and as a governmental telework promotion.

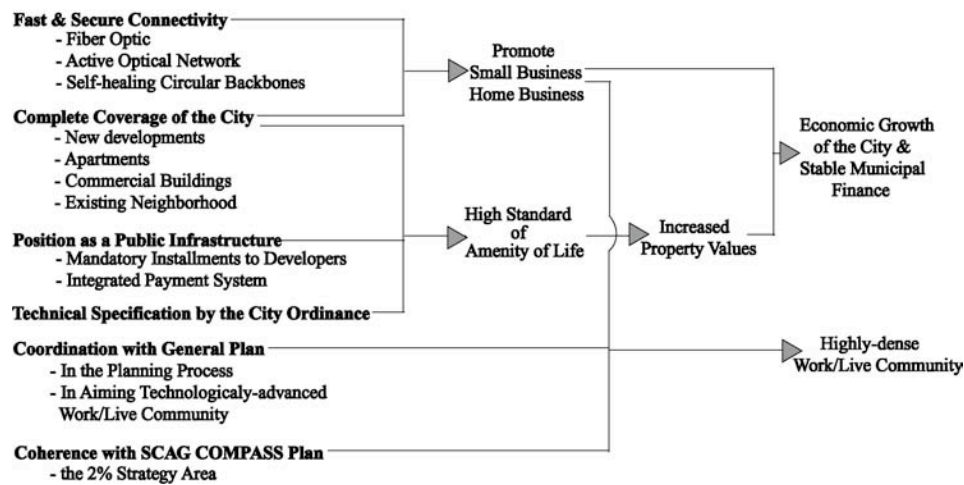


Figure 10. Possible Effects of LLCCP

Lastly, we, as urban scholars, would like to point out the issue of whether or not this possible success of municipal IT program as an urban policy will always contribute to the good of urban condition of the larger region. As mentioned in the introduction of this chapter, the decentralization of the cities as the possible result of IT and telework has been discussed much. If it happens or not, or whether it is good or otherwise is not the subject of this chapter. Yet we probably should not deny the possibility that a policy like LLCCP in suburban areas could cause the flow of the population out of the metropolises, which is not necessarily the result of natural overflow of the population. In other words, a good smart-growth policy in the municipal level of this kind can generate the urban decentralization or not-so-smart growth in the larger region. In addition, since the people who are likely to outflow in this way are with the limited socioeconomic profiles, a policy of this line could trigger the larger division between the metropolises and the others or the harsh competition between the cities.

This issue is not solely due to the IT infrastructure program as an urban policy, but more generally due to IT and telework. However, especially because a policy of this kind may successful and can be seen in more places, we should take this issue of larger region into the consideration.

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As the next step, we would like to pursue long-term observation and more detailed research to verify the degree of its contribution in Loma Linda case. We will also explore other cases of municipalities to test the possibility and limitation of generalization of such policies, which will help us to see their impact on our cities in the future.

Endnotes

1. The installation to the existing houses is not mandatory unless the remodeling is more than half of the structure. However, the city will install infrastructure up to the connection point on the streets and sign the service contract with the neighbourhood, based on their interest.
2. The next draft is not ready for the public at the time of this writing.
3. Metropolitan Planning Organization is a regional transportation planning body for metropolitan areas. Federal Highway Administration certificates its planning process.

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Has Telework Failed? A Survey Among 31 International Telework Experts

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Abstract: In this chapter we want to find out what has happened to telework, or similar terms. To supplement our own ideas, we mailed a request to 45 people around the world who knew a lot about this topic. These people were either researchers or consultants. We received answers from 31 of these experts. Some of our main findings are that all respondents agree the topic of telework gains less interest both in popular media and research than some years ago. Several of the respondents mentioned the priorities of EU as an important explanation why telework benefited in the mid-1990s. Several respondents commented on the lack of learning among people involved in telework research for more “practical activities.” Several more argued that forecasts for telework were too optimistic. Some claimed the limited success of telework due to lack of positive cost/benefit for organizations. Not all types of telework are failures however: Several respondents mentioned the lack of agreement on the definitions of telework, and the confusion about the different types of terms. Some respondents admitted that the collective types of telework (telecottages and neighbourhood work centres) had experienced particularly poor success. Also, the assumption of full-time telework at home five days a week, could be regarded as a failure. Some of the respondents claimed that the reduction in interest was because the same research questions were repeated over and over again. Others, on the other hand, state that there are still unresolved questions, but these are of a more fundamental theoretical and methodological nature.

Keywords: telework, diffusion, failure

1. Introduction and Contents

1.1 Introduction

In one of the nostalgic songs by an old Norwegian singer Odd Børresen he wondered what had happened to a lot of things in Norway, like wooden skis, old fashioned clothes, or politics from the 1970's. We got the same association when we attended a large international conference in information systems in San Diego in May 2005. Among 450 papers I was the only one who presented a paper on the topic of telework. There were however several papers on e-collaboration and virtual organisation. The contrasts are

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however amazing compared to the situation from the late 90-s, where both academic or practical conferences on telework were organized, both in my own country and in several other countries. There were at least one Web-page addressing the topic of telework in most countries, and several research programs took place and several Theses' were written at the universities. In the newspapers and in the popular press there were articles about telework almost every week. During the last 3-4 years there seems to be less interest for this topic. We also have fewer surveys or statistics telling us about the level of diffusion of this form of work, or experiences with existing projects. At times we see statistics, telling us that this "phenomenon" has increased or will increase in the future. Other popular articles claim the opposite, saying that telework is still a small phenomenon and does not "live up" to previous forecasts.

The research question for this chapter is not primarily to present statistics of the number of teleworkers, or whatever we call this phenomenon. We rather want to start a discussion of the reasons why the interest for telework seems to be so marginal today. And referring again to the Norwegian poet Odd Børretzen: "What happened really to telework?", and more concretely: has it really failed?"

1.2 Contents

In the introduction this chapter will give a short review of some characteristics of the research on telework through its more than history of 30 years, from Jack Nilles launched the concept as an answer to the environmental challenges in California in the middle of the 1970's. The overview will focus on managerial aspects, and will structure the research interest into time periods.

In the next part of this chapter, we will present three possible explanations for the seemingly reduced interest for telework, and present three possible explanations for this: a) failure, b) diffusion and c) modification of the concept. We give some general descriptions and explanations, and supplement with possible theories that can be applied. Thereafter we present the methods for data gathering, the results from one of the explanations: the failure hypothesis. At the end of the chapter we analyze and discuss shortly the validity of this explanation compared to the other two.

1.3 Methodology

We have witnessed the development and diffusion of telework and similar concepts since the end of the 1970's, and we will use our experience as a basis for the descriptions and analyses. But we have supplemented my knowledge from some of the most influential international experts on this topic. We sent a survey to 45 of people who have been involved in the telework field, all over the world. 31 of these have returned the survey, which give a very high face validity of this study.

1.4 Benefits, relevance, external validity

This chapter will not conclude to say whether this hypothesis of diffusion is more valid than the other two, or even other explanations. The findings are useful to evaluate new forms of work, evaluate about their potential and diffusion, and identify critical success factors, and to propose new research topics in this area. This topic therefore should have relevance beyond the specific question of telework. There are a number of organisational phenomenon which have "disappeared" without closer analysis and evaluations.

2. Some main points from the research on telework

2.1 Telework, definitions and alternative concepts

The most common definition of telework is to say that this is working tasks carried out in a geographical distance from the office, supported by ICT. This is often associated with homework, but this term also includes other arrangements, as telework centres or mobile telework (that means working from other places than the office like in a car, in a hotel or at customer premises). Also virtual teams, virtual organisations and even work on distance from your customer in call centres are included. Mobile telework has the fastest growth during the last years. Other names for mobile work are nomadic work, flexible work, virtual work, e-work, ecollaboration, distributed work. All of these including work at a distance supported by ICT.

2.2 Focus of research

The research on telework has been focused on definitions, driving forces and motivations, classifications and alternative arrangements, estimation of diffusion, technical solutions and legal aspects, forecasts and potentials, together with analysis of effects for individuals, organisations and society. A lot of the research on telework has been concerned of which types of work tasks and which persons are suitable for such work arrangements. Conclusions are relatively uncontroversial saying that not all jobs or not all people have a potential for telework. During the years there has been more focus on work-tasks than complete jobs, that means that certain work tasks but not the whole job are relevant for telework. But the general requirements tell us that tasks should be information oriented and be supported by ICT. People must be independent, have self-motivation, and have ICT-skills above the average level. Throughout the years there have been several studies on management and organisation of telework, which will be used as a reference for our descriptions and analysis in this chapter.

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2.3 Some research findings related to management of telework

We have done research on management and organisation of telework during the last ten years and the most important research finding are reported in Bergum (2000) and Bergum (2005). Some of our key findings from this research are listed below:

- Management of telework must happen through management by objectives and to trust the teleworker, because detailed control is not possible.
- Teleworkers must work more independently than before, and this requires more self-management and more self-motivation.
- Telework is more difficult than traditional work, both for the leader and the subordinate. This is due to the fact that the usage of electronic communication media has increased, and there is less spontaneous communication. There is a higher need for planning in communication, and it is easier to misunderstand because of more lean media. Good communication is important in telework, but also a challenge. It is important to maintain the communication frequency at a distance, give feedback via email, and to be specific in communication to avoid misunderstandings. Telework might be "out of sight – out of mind", so it is important for leaders to be aware of subordinates if he does not see him regularly. Alternatively the leader should contact the teleworker to find out whether everything is OK.
- Right choice of communication media is important, for example not to use lean media for negative messages.
- Management at a distance requires also proximity: face to face meetings, visits by the leader at the remote office and even at home.

Often the so-called "soft aspects" are the largest challenges in what we call management at a distance: how to motivate at a distance, how to communicate about social relations via electronic networks, and how to give feedback about negative and difficult work tasks. How to find out whether the teleworkers are OK when more lean media are used? And there is a challenge to maintain corporate communities and corporate culture in a geographically distributed organisation. More about our research on management of teleworkers can be found in Bergum (2000) and Bergum (2005).

2.4 Short about some myths in telework

There are a lot of myths related to telework: Firstly, there have been problems to agree on the definition of telework. Another aspect is about the diffusion, where some people claim telework to grow at a fast pace, while others say the opposite: that the numbers are stable. The truth is probably somewhat between. Related to the debate on definition, many people have associated telework to be "homework 5 days a week", while the most popular form now seems to be mobile work on part time. Full time telework has not been popular because the social costs then are too high, and teleworkers need to meet regularly.

Further: it has been assumed that telework is mostly for women in remote areas working in routine types of jobs. The experiences are however that teleworker often are well educated men in daily commuting time from the bigger cities.

2.5 Some phases in the research on telework

In a previous paper (Bergum, 2005), we propose a five-phase development of the research on telework, mainly based on the research on managerial aspects.

Time Phase A: "Pre-telecommuting period", before 1980

Research in this time period consisted of theories that seemed to suppose that leaders and subordinates are at the same place and communicate face to face. This referred to the period especially before 1980. *Time phase A, before 1980, is therefore called: "Pre-telecommuting period".*

Time phase B: "Telecommuting period", in the 1980's.

This phase or period had a focus on definitions of telecommuting, and discussions of advantages and disadvantages of the concept. Home work and jobs in shared work spaces in the local community were the locations of telecommuting work. This time period covered most of the years during the 1980's. *Time phase B is therefore called: "Telecommuting Period, and happens in the 1980's, with a focus on the broader social and political aspects of remote working.*

Time phase C: "Management control period", first half of 1990's

The research topics of relevance to management in the first half of the 1990's were the introduction of telework, strategies and plans, formal agreements and particularly the question of managerial control: "*How can I know that they are working when I can not see them?*", is repeated in numerous popular articles. Telework was assumed to require a very different style of management: Management by objectives instead of management by seeing, including good communication skills. The administrative aspects of managers were in focus, including the need for planning and information dissemination. Home work was still the dominant type of telework, but mobile type of telework was introduced slowly into the statistics. *Time phase C is therefore called: "Management control period", and happens in the first half of the 1990's.*

Time phase D: "Leadership period - trust and motivation", around 2000

Because of the rapid introduction of email and Internet during the last years of the 1990's, the administrative tasks were well supported. The most challenging tasks to conduct over distance and by means of more lean communication media, were the "soft" people issues.

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Because of a growing number of electronic media, there was also a need to choose the right combinations of media. Even if we emphasized the need to concentrate on the soft factors of leadership, there was also the need to balance these against the administrative duties for the managers. Distance management was to be more based on trust. This period occurred at the end of the 1990's and the beginning of this century. In this time period the fastest growth happened for mobile type of telework, together with part-time and supplementary work at home. *Time phase D is therefore called: "Leadership period, focusing on trust and motivation". Time: around year 2000.*

Time phase E: "E-leadership", multiple arrangements & distances, 2002 and later

This fifth period covers the present situation. Together with the growth in mobile telework and supplementary home work, the emphasis is now on new spatial organisational forms like virtual teams, interorganisational arrangements like virtual organisations, and distance relationships to customers through call-centres. In this fifth period there is a trend towards more sophisticated use of broadband, visual services and ecollaboration, among the most advanced users and a growing number of others. Telework and alternative work arrangements have diffused beyond the innovators. One of the interesting questions not addressed before, concerns the challenges to manage more average skilled workers at a distance. Because of the general trends in society towards more specialization and globalisation, members in an organisation must handle several distance dimensions, with a lot of different electronic media. Generally, organisations will be more dependent on distance relationships. We can call this period "E-leadership", to manage the increased complexities in these new spatial structures. Perhaps in the future the E will disappear, because distance and use of ICT are naturally integrated in the structuring of organisations. *Time phase E is therefore called: "E-leadership: focusing on management over distances in different organisational arrangements and alternative distance dimensions". This period started three of four years ago and does still exist.*

Summary

The research on management at a distance has been dominated by a lot of normative and popular papers, especially in phase B and phase C. The types of remote work have been telecommuting and telework at home or in the local community. During the last six to seven years there has been more research based work, focusing more on mobile work patterns, virtual teams, virtual organisations, e-collaborations and call-centres. This means a number of spatial structures and distance dimensions. The original concept of telecommuting has been modified throughout the years. Management issues have gone through periods of non-existence, through control and administration, via balancing with leadership and people tasks, to e-leadership with a multiple of distance dimensions.

3. Reduction in interest and possible reasons

3.1 Indications of reduced interest

As mentioned in the beginning of the chapter there are some indications of a lower interest for telework both in the popular press and within research. We mentioned our own experiences related to the number of student projects, a reduction in our Web-page in Norway: "www.fjernarbeid.net", the number of researchers and papers at conferences, reduction of stories in the newspapers, reduction of updated Web-pages and reduction of research projects. We have not the intention to measure the quantities ourselves. We can rather refer to studies made by Telenor R&D i Norway, Lennart Stureson and Jon Rognes in Sweden, and Diane E. Bailey and Nancy Kurland in a scientific paper in "Journal of Organizational Behavior in 2002". This last article indicates a reduction in the number of references over time, but his is mostly popular references and research related to case studies and general surveys. Interestingly there is a more stable development for more scientifically based papers including for example testing of hypothesis and building of conceptual models. These authors also refer to the problem of measurement, for example what is included in the telework-concept. There are probably publications that are registered or not depending on the names or concepts used. Another aspect is that the articles are based on very different scientific traditions: including both technology, information systems, social science, geography, organisation theory and management are some of the most relevant research fields relevant for telework. A hypothesis could be that the phenomenon of telework to a growing extent is incorporated in the specific research fields rather than being an independent research- topic in its own.

Anyway, we take as our starting-point that the general interest for telework has gone down during the last few years.

3.2 Possible explanations for the reduction in attention and research

We are interested to identify reasons for this reduction in the interest for telework. This knowledge is of course interesting as an independent phenomenon. But more broadly this is also relevant knowledge in understanding how organisational concepts are created, diffused, changes or eventually disappears or "dies". Probably also other terms in organisation science are "born", modified and are going through the same "life" as telework. The purpose of this chapter is to propose some possible explanations for this reduction in attention and research. Through empirical contributions from international experts on telework, we will have their reactions to these hypotheses. In this chapter we will mainly focus on one of these explanations.

Initially we will propose three possible reasons for the reduction in attention and research on telework:

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3.3 Reason a. Telework has failed

Trials and projects with telework have not been up to the expectations, and the penetration is lower than the forecasts made earlier. The explanation could be that telework arrangements have been cancelled because of bad experiences.

We know there has been a change in focus from the original perception of telework as full time home work and telework centres. The forecasts for these arrangements from the 1980's and 1990's have not been reached, and the diffusion of for example full time home work is much lower than earlier forecasts. Many people will therefore say that these types of telework have not been very successful, and that telework therefore has been a disappointment or failure. Many people could agree on this. It is however difficult to have a good overview of the experiences. There are far too little reports of trials showing bad results, as failures are often underreported in research. Probably there are a lot of projects and field trials with telework which have not been up to the original expectations. We know personally several pilot-projects in Norway which have been terminated before full-scale implementation has been made. We also know that EU has reduced its research on telework because many results have been disappointing and that the diffusion of telework has been slower than expected. There are however also other explanations, saying that the reason is because there were too few innovations in the telework research, and the same questions were repeated over and over again. Another argument supporting this main view is that telework has reached its "natural potential", which is almost in line with the next possible explanation: telework has diffused and is now common.

3.4 Reason b. Telework is common (has diffused)

Another explanation is that telework is now so common, and has a large penetration, meaning that the prefix "tele or remote" should be removed. Telework is for many people in today's working life a normal part of work. Many people work over geographical distances supported by ICT, and at untraditional places. This is no longer unique, so a special name is no longer needed.

Because we only to a limited extent refer to statistics on telework, it is difficult for us to discuss if telework has been common in working life. We have however an indication through our study at Norwegian Public Road Administration (Bergum and Selvik, 2004) that telework now has been introduced among organisations, persons and jobs that are not among the innovators. This indicates that telework has diffused beyond the innovators. The level of penetration however depends on the indicators chosen. Often the number of employees is used as an indicator, for example the number of people working at least one day a week at home. Then the number is not more than between five and ten per cent of the employees. A Norwegian survey in 2004 rather used the number of firms that permit their employees to telework as the indicator. The results showed that 50% of Norwegian companies allowed their employees to telework. The conclusion of diffusion is therefore dependent on the definition. As the Danish professor Lars Qvortrup said in the late 90's: to measure telework is almost to measure with elastic band.

3.5 Reason c. Modification of the concept

A third explanation is that the telework concept has changed, and that the concept has got other names like e-work, virtual work, mobile work etc. While telework originally was meant to be full-time work at home, to reduce commuting, support regional development especially through routine information jobs for women, the concept has been modified through the years. Telework happens mainly part time or at night, and the main target group is men in urban areas. One reason for this is the possibility to combine work at the office two or three days a week, with a reasonable daily commuting distance. The original idea with telework was work over geographical distance supported by ICT. This is still true, but the home is not the main location for telework as originally anticipated. The distance towards business partners internally and externally together with customers has shown to be more important. Today we rather talk about e-work, virtual work, nomadic or mobile work, or flexible work, with the office as a main base, but at the same time with a lot of other work locations for the individual worker. This is also because of specialisation and globalisation in working life.

Even if we have three alternative explanations, they are also interrelated. A change in concept can for example happen because the original concept of telework did not succeed.

3.6 A possible theory to support the explanations

We have not the intention in this chapter to rank the different explanations or hypothesis. But we present a couple of possible theories related to the first explanation: that telework has failed.

The most obvious theoretical explanation is to use theories for innovation and diffusion of these. Innovations reach new user from innovators to so called "laggard", and newer versions also includes that the innovation objects is reinnovated or remediated over time (Rogers, 2003).

4. Empirical part

4.1 Introduction, the sample

In November and December 2005, we sent out a questionnaire to 45 people all over the world, by email. All these people have been involved with telework or new working arrangements, either from a practical point of view as consultants, or as researchers. These people were selected among people I had met at international conferences during the last ten year, or selected from articles or projects on telework, found on the Internet. An answer was received from 31 of these people. Among the 31 respondents, I think that I have met around 20 of these people personally. Personal relations were positively related to the response rate, as most of the people who did not answer, were people I had not met face to face.

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Of the 31 respondents, a number of 20 were researchers and the remaining were practitioners. Nine countries are represented among the respondents: Norway, Sweden, UK, Belgium, Netherlands, Germany, Canada, USA and Japan. Most of the respondents are from Norway, Sweden, UK, Canada and USA.

The respondents all have a lot of knowledge about this topic. Therefore the face validity of this study should be very high. We should however be aware of the fact that several of the respondents who have been consultants and have promoted telework, could have some bias saying that telework has been successful and has diffused a lot. Results showed that respondents with a more practical background presented answers that were more biased toward explanation b, talking about the high diffusion of telework. Generally, also the answers from the practical people were shorter than the ones from the academic people, not surprisingly.

4.2 The questionnaire

The questionnaire was sent by email, and we received the answers by email. Half of the answers were received without any reminders, but we sent an extra email to the others in the sample. The content of the survey was quite simple. The first question was about statistics for the level of telework or similar concepts in their country. The second question was to discuss the alternative three explanations for the reduction in interest for telework. A short description of the three alternatives was included in the text.

In the next subchapter we will present some of the comments we received. There were large variations in the length of the written answers, but also the “quality of the answers” varied a lot. I will start by referring some of what we regard as the most analytical answers.

4.3 Answers

In this sub-chapter we will present some of the answers from respondents that had opinions on the a- hypothesis: failure. For most of the examples we have only selected the arguments for alternative a. For a few respondents we have chose to present their total answer including also comments that alternatives b and c also could be part of the explanation. Among the 31 respondent, a number of 7 or 8 had alternative a as their main explanation. But some of these also said that b and c also were part of the answer.

Most of the respondents had a combination of alternatives b and c as their main argument. We will give a couple of examples and some general comments on these answers at the end of the chapter. Even if a minority of respondents have alternative a as their main choice, it is important to analyze these arguments, to improve our understanding of telework and new working arrangements.

Generally, there were scientist who supported alternative a. Especially people who had been telework consultants supported alternative b, that telework had diffused to be a normal part of business practices.

In several of the questions the respondents refers to alternatives a, b or c. These are the three alternative reasons or hypothesis mentioned earlier. We do not refer all answers, but some examples of answers related to hypothesis a: failures. The answers are divided into

two groups: researchers and consultants. We do not refer to names, and try to make the answers as anonymous as possible. In some cases we can find out that the respondent is from Sweden, Belgium, Australia etc.

Examples of answers from researchers:

No 1:

“Failure: As a large scale solution – yes. This has not been a solution for all, or for a large part of a company”.

No 2:

It is difficult to choose one simple explanation. I think that all three alternatives have some explanatory power. Regarding alternative a: I think that the visions to substitute travel (that means telecommuting) by means of working at a distance have been a failure. The same with studies indicating that telework could be a substitute for collocated work. The main reason was that their assumptions of communication and work were too mechanistic and simple. Another reason, not mentioned among the three alternatives, is that the telework research itself, may be was not good enough. A lot of the telework research addressed questions already in research by other research field, like learning in organisations, organisational change, domestication of technology, communication in organisation etc. As this research field only managed to provide case studies that only to a minor extent could be related to each other or was built on common methods or techniques, this became a research field that did not had an image to be dynamic or exciting. Research on alternative work arrangement based on ICT is still there, but is conducted within other research fields or under other terms or names.

No 3:

Telework has failed insofar as the business case for its introduction has not been able to convince more employers than those who are currently using telework. But basically this failure is not one of telework itself, but of the concept of telework as it was promoted by “experts” and futurists. Many of these have failed to take into account that the issue of **control** is central to work relationships, and to production systems in more general. Management by outcomes/results is all very well on paper, but is much harder to truly implement in reality. Direct control is today often replaced by more indirect means of control, but these generally rely on trust relationships to exist between principal (superiors) and agent (workers). Trust becomes more important all the time, and is much harder to establish if face-to-face contact is limited. Control of labour also becomes more important because the overall market conditions are becoming more and more volatile and unpredictable. As researchers of distributed team work have shown repeatedly, tight, face-to-face interaction becomes more important the less stable the overall conditions are and the more vital it is to create a common understanding of goals, strategies, behaviour, codes.

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In less knowledge-based jobs, control of teleworkers would be possible in theory – given the technical possibilities, it could even be much stronger than in co-location situations – but at least in Europe techniques to systematically collect data on teleworkers are not accepted by society, and they are also often illegal.

The original idea of telework has also failed insofar as spatial decentralisation of work has not been found to contribute to the reduction of travel volumes. The reason for this is that telework – like most other ICT-based innovations – will not lead to socially beneficial outcomes unless it is being actively utilised by policy-makers to support strategies towards, for example, the reduction of individual traffic. As the general trend in travel and settlement patterns, themselves caused by overall economic developments, is towards growth of traffic volumes, and telework has – with exceptions – not been used as a policy tool to counteract these trends – telework is likely to strengthen dominant trends.

The main area where telework-related developments have had a huge impact on existing structures is in (what is sometimes called) tele-collaboration. I have a few years ago called it “in situ telework” because the work location does often not change at all (as opposed to the original concept of, mostly home-based, telework), but the spatial reach of the work processes an individual worker is involved in has multiplied. This trend is not driven by the needs of workers (although it may be in their interest), but by general economic developments in advanced Capitalism (globalisation of production, new international division of labour, market liberalisation, etc.).

No 4:

I mostly support explanation a, but with some elements from b. Telework was a very rhetoric topic that reached my country twice, in the beginning of the 80's and the middle of the 90's. The efforts by some actors to blow up the interest for telework was so successful that it became a strong discourse for some time. But these efforts did not result in a large penetration of teleworkers, however a technology for telework adapted to modern communication technology, where teleworkers seem to be innovators in application of new technology.

Another explanation to the reduction in attention is also that researchers lost their interest. This might have happened because most of the research problems were solved and there was not more to be said, and other research topics were given priority by the research councils. Researchers also have to adjust to the market. We can say that researchers and media amplified each others interest or lack of interest.

No 5:

I would say ‘failed’ in some settings: “My country’s” public service and some state public services have had formal trials but all have failed to my knowledge because of the culture favours ‘visibility’ over outcomes in the bureaucracy.

Two significant groups use it very little, people lower down the hierarchy and executives. The latter still widely distrust most employees and in my country we do not want most employees to have access to it. There remains in this country still very limited

understanding of the practice amongst managers, how to implement it, what would be gained, how to avoid the dangers. In a large-scale survey in 2002 I found only 4% of organisations in this country had full-time tele-homeworkers.

No 6:

The big resistance to telework is still management, however, part time telework is getting more and more common, and many people do not really use the term telework. Look at any North American airport, people are working like shit, same in airplanes.

Many companies also do disaster planning, this started in the early 1990s in California, the State of California has set up their employees so that they can continue working even if the office is crushed in an earthquake. This also enables telework.

Some companies report ICT problems and data security issues for not using telework. The windows platform that is used in the corporate world is running a losing battle against viruses, spyware, and you name the shit. That has been a factor in limiting telework.

Question you did not ask: Much of your perception may be due to an academic field that never took off, my guess is that research on telework never produced good theories, or enhanced existing theories, and the internet as a research field took much of the attention, instead of working seriously on how telework research could inform theories on work, organizations, and management, people just took off to other new and exciting areas.

No 7:

I think telework can not answer all questions and there are positive effects, but also negative effects. It has not really failed though, when you see that more and more employees and employers make use of telework. But may be the novelty of the topic is gone, and as you say, telework is common, I would say a combination of a and b. Moreover, many people including governments do not focus anymore on telework as a solution to for instance air pollution and traffic jams. It is not in their heads anymore, or they still see the pitfalls more than the solution.

No 8:

Telecommuting was incredibly over-hyped. The actual amount was never very high, but organizations with vested interests in the subject kept coming out with projections of ever higher current and forecasted levels of telecommuting. On the basis of shoddy research, great productivity gains were touted. However organizations were not experiencing any measurable impacts on the bottom line.

Most people really don't want to telecommute on anything other than an occasional basis i.e., one day per week. I was involved in a research project in the 1990s. While interviewing I asked an employee if she might be interested in telecommuting. Her answer: "Well, if I had to."

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No 9:

I support b, but will explain the reason for low research interest. That is because we know the answers, as support of alternative B means: it is common and is commonly done. My own research has moved to the team unit of analysis (virtual teams). While I think there is still room from theoretical research on telework, most of the issues are fairly well understood. At the team level, there are many more issues due to the interdependencies of people and the challenges of working at a distance (some issues are the same as those faced by teleworkers).

Examples of answers from consultants and practitioners

No 1:

I think it is a little of both, but in the following proportions: 10% failure, 30% diffusion, and 60% modification. The number of true failures, which I define as employers doing the right thing but getting bad results, are small. I do not consider penetration lower than earlier forecasts as a sign of failure of telework, if anything it is a sign of failure in forecasting. Some of those early forecasts were so wildly optimistic as to be totally unachievable. The other two explanations are much more interesting. The diffusion outcome was to be expected, as with any innovation. In fact, by definition an innovation is something that is meant to be adopted more widely, isn't it? The stage of early innovation with telework was over at least 15 years ago if not more. However, and this always confuses and bothers me, to this day we still hear the same kind of questions about telework that were asked and answered 15, 20, 25 years ago. It is as if, as I've said many times, there is very little cumulative learning. On the other hand, when I look at some of the HR journals these days I see articles that cover topics and approaches that were discussed to death 15, 20, 25 years ago as well. Last, the modification explanation, which is most interesting to me. I firmly believe that the concept of telecommuting/telework has generally morphed into a much broader view of workplace mobility, a decoupling of the activity we call office work from the place we call the office. The traditional (and increasingly narrow) view of telework as home-based work is becoming very well hidden among all the other varieties of mobile work and that is how it should be. Even if that is true, however, we need to remember that there will always be some unique characteristics of telework/mobile work that happens in the home (as opposed to work done in airplanes, coffee shops, etc.) simply because of the intersection of work and life that is so much more evident in home than in a Starbucks.

I often wonder, and worry about, whether telework has failed or faded away. I have come to the conclusion that it is just about where it should be, with one key assumption that must be accepted. I never believed that telework would be as widely and universally adopted as something like employer-paid life insurance or anything else that is suitable for every employee, every job, and every employer. It is nothing more than an alternative or option to be used where it makes sense. The problem is that even in 2005 we are still living under the influence of 300 years of centralized workplaces, and under the influence of generations of managers who were trained to and reinforced/rewarded for managing with

their eyes instead of their brains. Will this problem go away as the generation of managers now in their 50's and 60's retire and die? Perhaps yes but not entirely. I think we'll see smart managers and smart organizations use telework to the extent that they believe it helps them solve critical business problems. The other ones will continue to struggle with it and ask the same old dumb questions for the next 20 years.

No 2

I have predicted for many years that we would know that telework was successful when the name telework (or the many other names given to remote work) no longer was used: as you have said in Explanation b, people just do it. They no longer consider it in any way unique. Technology including access to high speed, always-on Internet has meant that the home office is "just like being at [the employer's] office."

But the concept has been modified in that people are working not only in their homes but at many other locations distant from their employers. As the tools of work have combined and become pocket-sized or smaller, remote work becomes a matter of course. We are just about there with the all-in-one office (cell phone, PDA, Internet access, camera, GPS etc.) with which one can work from anywhere in the world.

Still, management resistance means that not everyone teleworks (defined as working remotely during normal business hours) who has the tasks and technology that would let him or her do so. I have just helped the first school district in the US implement teleworking for their non-teaching staff. It still takes demonstration of the benefits to overcome objections to change.

I have noticed that presentations on teleworking are showing up at more academic conferences now. There were several at this summer's Academy of Management international conference in Hawaii. The subject is no longer new, thus less exciting to discuss. It is interesting that those of us pioneers implementing programs in the '80s got it right. There have been few new issues to ponder—mostly restating the benefits and resistance to change that we've gone over again and again.

No 3

I think the explanation of the low interest for telework can be a combination of the explanations above – and a few additional ones:

A. Yes, the expectations were high, and especially the experiments with "Telecottages" and "Neighbourhood work centres" can be called failures as they did not lead to permanent establishments. On the other hand, all the arguments for telework are still there, and some of them have even become stronger, e.g. those related to environment protection, traffic congestions, high commuting costs, road accidents etc. I think one reason to the silence about telework is that we failed to keep the discussion alive!!

B: Telework is very common in my country as it is in all the Nordic countries. It is today often regarded as "normal work" and I know that as well the unions as the employers confederations are very happy with that. When regarded as normal work there is no need for special arrangements, special agreements etc.

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C. Yes, people who telework do not regard themselves as teleworkers – they are just “workers” so to speak. (See B)

D. We have had silent periods before. In late 80-ties and the first years in the 90-ties media was not very interested in reporting on telework experiments. They big boom came about ten years ago when the EU Commission took up telework/ework as a preferred issue.

E: The burst of the ICT-bubble around the millennium shift was important. Nobody was brave enough to address the opportunities of ICT – especially when all ICT-companies where in trouble and people lost their investments.

No 4:

The basic fact is that mobile and flexible working using ITCs is commonly accepted, but not as telework. The concept is quite dead, but the reality is alive. However it is reaching a level saturation; although the technologies exist and are well proven, they are not sufficiently refined to enable take-up to move beyond the 10% of the population capable of handling them with confidence.

There is no doubt that telework has a lower profile now than it did three or four years ago. It has moved away from being a strongly profiled policy at European level to being more of a local or regional issue. In the 90s telework was seen by the EC and national governments as a vehicle for driving technology uptake by individuals, companies and administrations. This was soon superseded by the perception that e-commerce would drive technology uptake.

For one reason or another, the basic technologies have been taken up across Europe. The mobile phone is ever present and the majority of households have access to a computer and home and in the near future the majority will have broadband access. The interest in telework seems to have stagnated, but has in reality stabilised.

No 5:

Reasons for reduced interest are the following:

1. It is no longer an EU priority hence fewer research projects on it, therefore fewer words written, surveys etc
3. It was a concept that has now been turned into reality which like e-learning works much better as a combination – e.g. analogous to blended learning. A minority telework all of the time. Many more telework 2-3 days per week combined with office work.
4. It is seen much more as a norm these days and therefore makes less sense to promote.
5. It has had a major boost together with a variety of other flexi work forms resulting from legislation implemented in April 2003 and to be extended in April 2006
6. It made sense to promote much more when organisations were first changing over to it.

No 6:

Homebased work (which telework also was defined as), was mainly an employee-motivated phenomena. As the work marked got more unsafe an unstable employee-motivated organisations like that lost its actuality. Being out of sight based on own reasons was unsafe. Physical networking at the office got more important, I think. This might also explain the high penetration of telework in the Nordic countries earlier as the unemployment here was much lower than in most European countries. For this statement I have no research basis, but this might be a possible explanation.

No 7:

My answer to your question is threefold:

1. Telework in the broader sense has become sufficiently diffused and commonplace as to excite much less interest than heretofore. There are of course many companies (and public sector employers) that still want their staff visible in the office during their (mainly flexible) working hours. There are also employers who have some kind of formalised teleworking (or flexible working) scheme. But there are also many employers who simply take a permissive line with professional and managerial staff, who work at home when it makes sense to do so, and work at the office when that is more appropriate.

This may seem at odds with the report that by 2001 the numbers of people teleworking had only reached 8% of all in employment'. However the percentage would have been much higher had the researchers looked at all for whom teleworking is a realistic proposition, i.e. excluding the very large number for whom it isn't, such as chefs, waiters, bus drivers, production workers. The earlier study estimates potential teleworkers to be 22.6 of my countries workforce, suggesting that slightly more than one third of those who could telework do so!

2. The concept of telework has itself become sufficiently fuzzy as to not lend itself to either measurement or much serious debate as a topic. This has of course always been an issue even among those with a professional interest in telework or flexible working, to the extent that before embarking on any kind of discussion one is wise to set out clearly what is the particular topic on which one is focusing.

3. The early advocates of telework have become either bored, disillusioned, elderly or have themselves moved on to other interests. Given that we have been promoting telework for twenty years, it's hardly surprising that fewer new people take up the flag, since its no longer a "new and exciting" topic.

None of this is to say that the subject has gone away or even that it has reduced in importance. Here in my country one of the speakers at last week's "broadband summit" focused on telework/flexible working as a mechanism for improving productivity and addressing pollution/climate change. Sadly, the subsequent debate with the audience illustrated the fact that when the subject is raised the discussion as to its pros and cons and practicality has not really moved forward. To some it's obvious, others perceive significant barriers. Many continue to blame "management".

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As a personal view, I anticipate that teleworking in the sense of “working at a distance rather than travelling to a particular place to work or confer” will revive as a subject as higher performance broadband becomes more widely and cheaply available, and when video and related applications become better packaged to take advantage of this, in other words as the nature of distance communications between individuals and groups becomes significantly richer. Concurrently we will begin to become more conscious of the cost of travel and of the impact of travel on the environment. I'd expect to see the “one third who can, do” increase to two thirds over the next ten years. However, as now, much of this will be “part-telework”, “part-commuting”. Those who advocate a fully-teleworked approach actually impede progress because most managers intuitively understand that a fully teleworked workforce is only applicable in a very limited range of environments.

Of course all of this excludes the very wide take up of “collective telework”, as when work that was formerly in (say) a bank's high street branch is moved to a telecentre within the same country and then to a telecentre in another country with a lower cost workforce/overheads. All of that work could potentially become home-based.

5. Analysis of the answers

Even if the length and quality among the answers from the respondents, we found interesting explanations for the decline in interest for the topic of telework as well as for the reduced research interest. However, some people thought that research interest was still there, but under another umbrella. We can also notice that two respondents who supported the explanation that telework had diffused and was common, and held this as an explanation why the interest both from the media and the research councils had declined. So the three explanations have connections. And the three explanations, reasons or hypothesis could also be interpreted in at least two ways: as a reduction in interest for the topic telework, or as a reduction in research on telework. Both aspects are covered here, and especially discussed by the researcher.

Some of the comments which I will emphasize are the following:

a. Agreement on less interest:

The first finding is that all respondents agree that the topic of telework gains less interest both in popular media and research than some years ago: “There is no doubt that telework has a lower profile now than it did three or four years ago. It has moved away from being a strongly profiled policy at European level to being more of a local or regional issue”.

a. EU-priority:

Several of the respondents have mentioned the priorities of EU as an important explanation why telework received a lot of attention from the mid 90's, but when the interest if over, also media and research has lost their interests. The next couple of comments, c – e, more

specifically comment on other reasons for the reduction in the interest for telework, both commercially and scientifically.

b. *Lack of cumulative learning:*

One of the reasons for reduced research interest was that several respondents commented the lack of learning among people involved in telework research or more “practical activities”. The same questions were repeated over and over again. *“We still hear the same kind of questions about telework that were asked and answered 15, 20, 25 years ago”.*

Several of the researchers several said that telework research was too much case based, and was not built on common theories or methodologies. It did not take into considerations what happened in other research fields like organisations development, organisational communication etc. As one of the informants told me personally: I have not attended the telework workshop recently because in some way the topic is very narrow, but on the other side it is very wide because it covers topic from psychology, organisation theory, geography to information technology etc. *“As this research field only managed to provide case studies that only to a minor extent could be related to each other or was built on common methods or techniques, this became a research field that did not had an image to be dynamic or exciting. Research on alternative work arrangement based on ICT is still there, but is conducted within other research fields or under other terms or names.”*

Another researcher said the same thing, but with other words: *“Much of your perception may be due to an academic field that never took off, my guess is that research on telework never produced good theories, or enhanced existing theories, and the internet as a research field took much of the attention, instead of working seriously on how telework research could inform theories on work, organizations, and management, people just took off to other new and exciting areas.”*

c. *Telework was over-hyped:*

Several of the respondents argue that forecasts for telework were to optimistic. One reason for this could be interests from suppliers of ICT-services and –equipment, or political interests about the potential for telework to support regional development. *“Telework was a very rhetoric topic that reached my country twice, in the beginning of the 80’s and the middle of the 90’s. The efforts by some actors, to blow up the interest for telework, was so successful that it became a strong discourse for some time”.* Another respondent stated the same argument: *“Telecommuting was incredibly over-hyped. The actual amount was never very high, but organizations with vested interests in the subject kept coming out with projections of ever higher current and forecasted levels of telecommuting.”*

Another reason could be too simplified view of the potential for telework. As one of the respondents said: *“Their assumptions of communication and work were too mechanistic and simple.”*

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d. *Lack of economic benefits?:*

Some of the respondents claimed the limited success of telework to be due to the lack of positive cost/benefit for organizations: One said: "Telework did not convince managers about the benefits for the organizations" Another one said it in this way: *"Telework has failed insofar as the business case for its introduction has not been able to convince more employers than those who are currently using telework. But basically this failure is not one of telework itself, but of the concept of telework as it was promoted by "experts" and futurists. Many of these have failed to take into account that the issue of control is central to work relationships, and to production systems in more general."*

Besides control, also the need for visibility are mentioned by at least three of the respondents: *"My country's" public service and some state public services have had formal trials but all have failed to my knowledge because of the culture favours 'visibility' over outcomes in the bureaucracy."*

Another reason for the perceived lack of positive benefits could be that the driving forces for at least home based telework, were the employees: *"Homebased work (which telework also was defined as), was mainly an employee-motivated phenomena"*.

e. *Not all types of telework are failures:*

Several of the respondents mention the lack of agreement on the definitions of telework, and the confusion about the different types of terms: telework, telecommuting, flexible work, ework, virtual work, mobile work, distributed work etc. But respondents generally agree on the classification of the telework, in homebased telework, mobile telework, telecottages/electronic neighbourhood centrals, and the differentiation between full time telework and part-time telework. Some of the respondents must admit that especially the collective types of telework had been failures: *"Yes, the expectations where high,, and especially the experiments with "Telecottages" and "Neighbourhood work centres" can be called failures as they did not lead to permanent establishments"*.

Also the assumption of full time telework at home five days a week, could be regarded as a failure. This assumption has two failures: the home as the most important location, and that telework is full time. Experiences have shown us that the most promising application of telework is mobile telework, and that telework is only part time. This failure is due to what is already mentioned by one respondent the simplistic view of communication and work, and the social needs of human beings to see and meet other people.

f. *Disagreements on the need for more knowledge?*

Some of the respondents claimed that the reduction in interest was because the same research questions were repeated over and over again: definitions, driving forces, obstacles, alternative forms, forecasts, control issues, what types of jobs and persons are suitable for telework etc. Because of these numerous studies, we have solved the most central research questions, some respondents said. Others rather say that we still have several unresolved questions, but these are more fundamental theoretical and methodological ones, which are

now researched on in other research fields than telework. Often these belong to more general research fields like: organisation theory, geography, HRM, information systems etc.

6. “The concept is dead, but the reality is alive.”

In this last chapter of this chapter we will refer to a couple of the explanations from respondents, combining the three alternative explanations proposed. Some of them also added to the list.

In this chapter we have discussed whether the reduced interest for telework happens because telework has been a failure. We have said earlier that a major part of the respondents thought that the reduced interest for telework was because a) telework had diffused, or b) that telework now had been modified and had another name. As one respondent said: *“I think it is a little of both, but in the following proportions: 10% failure, 30% diffusion, and 60% modification. The number of true failures, which I define as employers doing the right thing but getting bad results, are small. I do not consider penetration lower than earlier forecasts as a sign of failure of telework, if anything it is a sign of failure in forecasting. Some of those early forecasts were so wildly optimistic as to be totally unachievable. The other two explanations are much more interesting.”*

We think that the statement from one of the respondents summarizes the situation in elegant way: *“ Mobile and flexible working using ITCs is commonly accepted, but not as telework. The concept is quite dead, but the reality is alive.”*

Two of the respondents clearly state that telework as a concept might be dead or gain little interest, but that dispersed work arrangements will gain more in importance:

- a. *“As a personal view, I anticipate that teleworking in the sense of “working at a distance rather than travelling to a particular place to work or confer” will revive as a subject as higher performance broadband becomes more widely and cheaply available, in other words as the nature of distance communications between individuals and groups becomes significantly richer.”*
- b. *“The main area where telework-related developments have had a huge impact on existing structures is in (what is sometimes called) tele-collaboration. I have a few years ago called it “in situ telework” because the work location does often not change at all (as opposed to the original concept of, mostly home-based, telework), but the spatial reach of the work processes an individual worker is involved in has multiplied. This trend is not driven by the needs of workers (although it may be in their interest), but by general economic developments in advanced Capitalism (globalisation of production, new international division of labour, market liberalisation, etc.).”*

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We can conclude this chapter by referring one of the respondents, who gives a threefold answer to our question why the interest for telework has been reduced:

1. Telework in the broader sense has become sufficiently diffused and commonplace as to excite much less interest than heretofore.
2. The concept of telework has itself become sufficiently fuzzy as to not lend itself to either measurement or much serious debate as a topic.
3. The early advocates of telework have become either bored, disillusioned, elderly or have themselves moved on to other interests.

“None of this is to say that the subject has gone away or even that it has reduced in importance.”

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Work-Life Balance

Home-Based Teleworkers' Constructions of Professional and Parental Identity: Traversing Gendered Roles or Maintaining Gendered Boundaries?

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Abstract: This chapter addresses the issue of the identity construction of people who work from home, and so no longer have the same level of access to the usual social and physical cues of a traditional office environment to draw upon. This, I propose, renders them more reliant upon discursive and material methods of communicating their notions of self. An analysis of discourses was undertaken upon the narratives of seven male and seven female teleworkers, to consider how they constructed themselves as both professionals and as parents. By employing the philosophy of social constructionism and the analytical framework of emancipation, I concluded that home-based telework is an important catalyst in allowing the renegotiation of priority given to these roles, and further more can provide a space where both men and women can utilize discourses considered more traditional for the opposite gender. It could therefore be considered a liberatory mode of work to some degree, however I also draw attention to the arguments against telework's emancipatory potential by presenting examples of the costs and paradoxes evident in the narratives of my participants.

Keywords: Home-based Telework; Gender; Identity; Parenthood; Emancipation

Introduction

My doctoral research, upon which this chapter is based, explored the experiences of people who work from home and asked 'How do home-based teleworkers construct their professional and parental identities?'. Issues of identity have recently come to the fore in organization studies, as a key way in which power relations can be examined, as ruling in and ruling out access, to organizational resources and status, for different groups. I was particularly interested in how men and women might differently create their identities in relation to the notions of career and family, in a context where professional and parental roles might become blurred. It is becoming increasingly common to find theorists asserting that people's identities are largely constructed with reference to their professional roles, but

a meaningful discussion about how the parental role also impacts upon the ‘project of the self’ (Grey, 1994) is yet to be heard. To address this knowledge gap I conducted videotaped interviews in the homes of a sample group of home-based teleworkers. This enabled me to explore how their identities were constructed both in talk and through material means, such as clothing and the layout of living and working space. In this chapter I will specifically question whether the context of home-based work can enable men and women to cross the boundaries of their traditionally assigned gender roles, and examine if this can be considered emancipatory in any way.

In order to provide some background to the research undertaken, the following section will give an overview of the context of home-based telework and a brief exploration of the relevant topics of identity; career; gender and parenting. I will also begin to describe the philosophy of social constructionism, which I have adopted for this project, and which informs the definitions I see as most appropriate in these subject areas. The key analytical framework, which I have chosen to use: that of emancipation, will be considered in the proceeding section. I will then describe the methodology employed, before presenting my findings and discussing these with reference to arguments for and against telework’s liberatory potential.

1. Background

Townsley (2003) suggests that the increasingly popular trend of home-based telework will radically change the way in which we think about the concept of work and furthermore has the potential to allow us to reconsider our priorities in life. The key tension of this way of working, as discussed widely in the literature, is whether ‘the living of two worlds in one’ (Felstead & Jewson, 2000) enables harmonious reconciliation of home and work life, or whether it in fact causes the two realms to conflict. Niles’ (1996) research participants reported that their quality of life changed positively on commencing telework, yet Felstead et al (2005) claim that home-based teleworkers can be ‘pulled in different directions by contradictory forces’. Similarly Tietze and Musson (2002) suggest that ‘the culturally different spheres are becoming more fused’, yet Surman (2002) proposes teleworkers feel that these boundaries have to be maintained (whether physically or symbolically) ‘as a useful way to make sense of and order their lives’.

The concept of identity has been explored widely through the fields of psychology and sociology and a wealth of perspectives have been developed, from those which see identity as existing cerebrally and independently, representing the essence of who we really are; to constructionist approaches – to which I am most drawn – which see identity as a performative social construction (Berger & Luckmann, 1966), whereby actors draw upon the discursive and material resources available to form their identities. Burr (1995) follows this approach and stresses that ‘for each ‘thread’ of our identity, there is a limited (sometimes very limited) number of discourses on offer out of which we might fashion ourselves’. Thus one can only utilize those discourses which are culturally available at a particular moment in time, and so our agency to be who we want to be is restricted – yet, I

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would argue, never entirely beyond our control. I follow Butler's (1990) interpretation, that discourses can be sites of resistance as well as oppression.

It is often expressed in the organization studies literature that work 'tends to dominate most of our waking moments, and sometimes our occupational identity is seen as the defining characteristic of the self' (Raskin in Archer, 1994). Giddens too (in Tietze & Musson, 2002) describes work as an 'ontological reference point' in identity construction, and explains how identity is usually 'embedded' in social contexts. Perhaps, with the arrival of home-based telework, work will increasingly be experienced as 'disembedded' – as the usual physical and social cues are removed. This therefore provides a context which brings issues of identity to the fore (Tietze & Musson, 2002).

Following a broad literature review it is clear that gender issues still tend to be explored from a feminist perspective and so a great deal of research which purports to discuss gender, seems to only address the female experience. I also found that parenting is a highly overlooked area of research in organization studies, and its direct impact upon working lives is rarely acknowledged. The concept of patriarchy is still prevalent in gender research. This is the notion that the masculine and the feminine are assigned differing levels of prestige in the hierarchy of our society, where behaviors labeled as masculine are given more 'cultural capital', resulting in a situation which reinforces women's subordinate position. In our capitalist society it is paid organizational work that attracts the most prestige, and parenting tends to be subjugated as women's work. Most contemporary research therefore has an underlying assumption that it is emancipatory to enable women to engage in the labor market – thus bolstering their standing in line with societies ideas of success. What most fail to question, however, is whether there is also emancipatory potential in facilitating more involved participation, by men, in parenting.

Bernardes (1997) suggests, 'the single clearest inequality between the genders in contemporary society relates to parenting'; and I too see this as an important issue to address. Many fields, in particular the emerging trend of 'family studies', have adopted increasingly critical approaches to idealized notions of the 'nuclear family': the idea that there is 'a clear division of responsibilities... the male is primarily the full time breadwinner and the female primarily the caregiver' (Bernardes, 1997). Bernardes describes this construct as quite simply unrealistic claiming that it 'omits the rich detail of everyday living'. Research based on a social constructionist philosophy, makes it possible to connect micro experiences of teleworkers to the macro 'bigger picture' of social inequalities: 'looking at how we construct, conform to or transcend notions of masculinities and femininities we can connect to subjectivities, experiences and intentions as well as to cultural wholes, broader patterns and social constraints' (Alvesson & Billing, 1997). Lupton (1998) describes how telework has the potential to shake up gender dichotomies yet it is also claimed that traditional gender roles, far from being weakened, are in fact made more pronounced, when people work from home (Wilson and Greenhill, 2004). I shall now define the topic of emancipation, which I will use as a lens through which to address this important debate.

2. Emancipation

It is one seminal paper, by Alvesson and Wilmott (1992), that I have chosen to focus upon in order to discuss the concept of emancipation. This is a review article, which describes the ways in which organization studies, and in particular Critical Theory (CT), have utilized and dealt with the idea of emancipation, and therefore provides a comprehensive summary of the key ideas relevant to this chapter (I have also given attention to their later work, eg. 2001, to ensure these ideas are not too outmoded).

According to Alvesson and Wilmott (1992) 'emancipation describes the process through which individuals and groups become freed from repressive social and ideological conditions, in particular those that place socially unnecessary restrictions upon the development and articulation of human consciousness'. They propose that 'through a process of critical self reflection and struggle, people can become freed from diverse forms of domination' (Alvesson & Wilmott, 2001). These might include the way in which both men and women may be confined to traditional gender roles – seeing alternative routes as not appropriate or legitimate, and not having access to the resources, both practical and discursive, to occupy roles and perform behaviours more commonly associated with the opposite gender.

Within organization studies there are three broad approaches to the topic of emancipation. Mainstream management's response to this topic, Alvesson and Wilmott (1992) claim, has been somewhat hard-nosed, with more orthodox commentators arguing that management has nothing to do with such notions. Also prevalent is a softer stance, which is concerned with management offering solutions aimed at 'freeing employees from unnecessarily alienating forms of work organization' (ibid), yet Alvesson and Wilmott (2001) stress that 'emancipation is not a gift to be bestowed upon employees but, rather, is an existentially painful process of confronting and overcoming socially and psychologically unnecessary restrictions'. This 'humanistic' approach to emancipation, Alvesson and Wilmott (1992) claim, although seemingly well meaning, 'is based upon a narrow and mystifying understanding of key prerequisites of emancipation... in which the emancipation of individuals is identified with the provision of opportunities for the fulfilment of their needs (as long as this fulfilment coexists with and, especially, improves organizational performance)'. And further more they claim that this approach may actually have the paradoxical effect of 'weakening employees' capacity to reflect critically on their work situation' (Ibid).

The third and most radical approach is that of Critical Theory (CT). Critical theorists propose that any substantial and lasting form of emancipatory change must involve individuals reflecting on their own circumstances and deciding to make changes for themselves. At its extreme, CT rejects the notion that 'the full expansion of human autonomy can be accommodated within the constraints of capitalist work organizations' (Ibid) and claims that any truly emancipatory project 'must encompass a much broader set of issues... such as the transformation of gender relations'. It is the approach of CT, to matters of emancipation, to which I am most drawn, as, in many ways, it parallels social constructionist thought, particularly in the attention paid to broader social structures and how these affect a person's choices and experiences of everyday life.

Alvesson and Wilmott also outline three key critiques to CT's approach to emancipation, which largely come from the poststructuralist movement. The first is intellectualism – the claim that CT is 'highly abstract' (Ibid) and lacks the practical application required to 'provide 'fixes' for organizations' (Alvesson & Wilmott, 2001). The second claim is that of essentialism. This is the idea, that 'beneath the alienated, fragmented surface of human consciousness there is an autonomous individual striving to come out' and this is irreconcilable with poststructuralist beliefs that are fundamentally anti-essentialist. The third critique is that of negativism, which claims that 'there is a tendency to one-sidedness in many critical projects' (Alvesson & Wilmott, 1992). This potentially makes CT unconstructive as it is blinkered in its goal of seeking fault with orthodoxy and ignoring any beneficial aspects. In this sense critical theorists can be seen as arrogant, by 'taking for granted the authority of their criticism' (Ibid). Alvesson and Wilmott's response to this charge is to suggest that 'the dangers associated with an exchange of the authority of one account for the authority of another must be recognised and reduced, if not eliminated' (Ibid). They suggest that this may be achieved by maintaining a self-reflexivity in analysis and by avoiding making grand claims that data cannot support.

Whilst these critiques 'inject a healthy skepticism into the heady, intellectualistic realms of CT' (Ibid) I do not believe that they 'necessitate the jettisoning of the idea of emancipation as a guiding value of analysis' (Ibid), which would be throwing out the proverbial baby with the bathwater. In sum, I can see the benefits of emancipation as an analytic concept and am keen to see what light it can shine on my data. I am optimistic enough to believe that 'social science can and should contribute to the liberation of people from unnecessarily restrictive traditions, ideologies, assumptions, power relations, identity formations, and so forth, that inhabit or distort opportunities for autonomy, clarification of genuine needs and wants, and thus greater and lasting satisfaction' (Ibid); and emancipation, though not entirely unproblematic, offers a lens through which to view data and offer interpretation.

My cautionary way forward then is to follow Alvesson and Wilmott's model of 'micro-emancipation' or the 'micro view of emancipation' (Ibid); which 'reformulates the grand enterprise of emancipation into a more modest project, scaled down in terms of scope and ambition' (Ibid). This view emphasises the importance, even of 'partial, temporary movements that break away from diverse forms of oppression'. One example of an instance of micro-emancipation, outlined by Alvesson and Wilmott, is the 'resistance to stratagems deployed in efforts to fix people's identities and self-understandings' (Alvesson & Wilmott, 2001); this 'occurs when critical reflection enables the development of an open attitude to the ascription of identity' (Ibid). By focusing upon micro-emancipation 'analysis can have more direct relevance to the lived experience of people who are continuously engaged in local struggles – for example, by raising awareness of the consequences of everyday decision making' (Ibid).

I will proceed then, by asking: 'To what extent can telework be considered emancipatory for both mothers and fathers? I will do this by analyzing examples from the men and women I interviewed, of traversing, what are commonly held to be fixed gender roles in the realms of work and family life. The key discussion will be around whether these incidences amount to even micro levels of emancipation, and crucially whether it is indeed

home-based telework that has enabled these occurrences. The cases for and against home-based telework being emancipatory for men and women will be considered.

3. Methodology

In order to address these aims I interviewed seven male and seven female teleworkers in their home-working spaces and recorded these using a video camera. I then conducted a comprehensive 'analysis of discourses', whereby I examined the legitimate and normalised ways in which the topics of work and family were presented by the participants. This allowed me to consider whether home-based telework can provide a site for opposing or subverting the traditional formulations of these heavily gendered concepts. Discourse analysis has its roots in the philosophy of social constructionism, which considers reality to be created through social interaction and so is fluid and multiple in nature, and is experienced subjectively by each of us. By using videotape to capture sights as well as the disembodied voices, normally afforded by conventional qualitative research methods, allowed me to consider how discourses are drawn upon and performed not only in talk, but also by material and physical means². All of the participants had children aged 16 or under, and were in managerial level roles, utilizing ITCs as an integral part of their work. They all worked from home for at least 50% of their working hours.

4. Data and Discussion

I will now present my findings and discuss these through the framework of emancipation, in order to assess whether home-based telework has the potential to liberate men and women from fixed gender roles, and indeed if this potential is realized in the experiences of my sample group.

The case 'For'

There is evidence in my data of women rebelling against traditional constructions of motherhood, and in a noteworthy example one participant rarely articulated care or affection for her children, preferring instead to focus upon her professional role, which she stated gives her more meaning. She constructed her parental role in line with traditionally male discourses of providing materially and in terms of setting a moral example. There are even points where she describes her husband taking over some of the domestic work in their home – the remainder being performed by paid employees. This woman provides an example of a female constructing a strong professional identity, by choosing to ignore traditional constructions of motherhood, and privileging her career over her parental role. In this way she exhibits an instance of micro-emancipation. Even in supposedly enlightened

² Whilst I have not overtly presented any visual data here (which is simply for reasons of space) I am aware that it will have certainly influenced the analysis. Some examples of the visual data will be presented at the conference and this issue will be addressed through my presentation.

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21st century Britain, a woman who puts anything before her role as a mother faces enormous personal costs and stigma. She deals with this by maintaining a narrative of being an expert and highly successful in her professional role, perhaps in order to make this 'betrayal' of her traditional gender role seem worthwhile and legitimate.

Whereas this example was extreme amongst the women I interviewed, a further, and more representative, finding has been that the wealth of roles, a woman has, become more visible when she performs her paid working role within the home. It seems that this is due to, her children in particular, seeing her more in her professional role, and acknowledging that she is providing financially for her family, in a similar (if not identical) vein to their father. This example of micro-emancipation is to do with the slow process of changing people's perceptions of women, and seeing them as more than just wives and mothers. Home-based telework seems to have this potential, if only within the microenvironment of the home – but this is after all a key space where our early ideas of what it is to be male and what it is to be female are formed.

Turning to the case of the male teleworkers I interviewed, a significant finding is that these men all expressed a desire to be more involved, caring parents (even though this desire is not necessarily always realised in practice). And they state that it is telework that has allowed them to feel more like parents, as they are present in the home: the domain of family life, for a larger amount of time than those in office-based roles. Additionally, they also report that they are seen as more physically and emotionally available by their families and, although this causes frictions for some, for most this is presented as an opportunity and a privilege. This situation, which telework has facilitated, can be seen as emancipatory as it involves the men breaking with traditional constructions of fathers as detached and uncaring, and focused solely on their roles as providers and breadwinners. The way in which, at least two of these men, claim to cope with this costly act is by choosing not to care about the heavily gendered traditional discourses of parenting in order to focus upon their caring roles as fathers: thereby 'not caring in order to care'.

The final example I shall focus on here suggests that when men work from home their wives are then able to return to the labor market, as their husbands are able to perform some of the childcare and domestic tasks that had previously prevented them from engaging in inflexible paid working roles. This is an example of a husband's choice to work flexibly having the knock on effect of liberating his wife from her traditional role within the home, to experience and formulate for herself a new identity as a professional, where previously, practical constraints had made this seem impossible.

In sum, it would seem that the most important thing that home-based telework does, in emancipatory terms, is to open up the space to re-evaluate one's priorities in life, and also provides an environment where men and women can perform roles and utilize discourses more traditionally associated with the opposite gender. The second, but no less critical, finding is that men's increased presence in the home can weaken women's confinement to this space, enabling them to engage in the labor market.

The case 'Against'

Here I will present some examples where telework has not enabled the traversing of gendered roles, indeed it has ensured the continuation of traditional discourses. Most notably, it seems that home-based telework may have had the affect of fixing the women interviewed more firmly into their traditional mothering roles, as they expressed contentment with, or desires to return to, roles where they can perform the majority of care for their children themselves. It seems that this occurs hand in hand with lowered aspirations to do well in terms of achieving career progression, and a general apathy toward professional life, which becomes secondary to their more traditional roles as wives and mothers. Telework was also described as enabling the women I interviewed to do housework throughout the day when, it could be argued, they should be focusing on their paid working roles, and these roles could suffer as a result. So it would seem that a result of women spending more time in their homes has been the reinforcement of their traditional roles. Rather than enabling these roles to be seen as oppressive, they are now seen as desirable for these women, and in this sense telework, which is the factor that brought them back into the home environment where once they had performed paid work in the public sphere, can be seen as anti-emancipatory.

In my data there is relatively little evidence that where women work, men pick up the childcare and domestic work (with just a few examples as noted in the previous section). And, as these women work from home, there is even more of an expectation that they can juggle all of these responsibilities on top of their paid roles. The women's time and attention therefore, seems to be stretched very thinly over the professional and parental realms – creating a very real danger that she will become seen as less proficient in both. Amazingly though, despite admitting occasional feelings of guilt, there is little mention of these women feeling inadequate in either role. It would seem that in choosing to prioritise their parental roles (as all the women do, with but one exception) they find a legitimate identity where they can feel successful as women.

Whereas the women seemed to find prioritising their parental roles a relatively straightforward choice, in line with the dominant discourses of what a woman 'should do', the men's approaches were more varied. One male participant for example chose the most straightforward option as a man, by engaging with the traditional discourse of being a breadwinner and privileging his professional role, whereas several of the men defied this convention, and like the women, focused upon being caring parents. Two of the men though, were unable (or unwilling) to prioritise either role and consequently suffered substantial feelings of being torn and inadequate, not being able to perform well in either. The role of home-based telework in this was in providing a unique level of immediacy between the realms of work and home life – putting these men in the tempting but unviable position of seeing the merits of both, wanting to 'have it all', but in affect are unable to achieve success whilst neither is given their full attention. This, it seems, echoes the position women have been in since the option to engage more fully in the labor market was made available to them, through the struggles of feminism and the subsequent changes in labor laws. Whereas women's resolution to this issue, it seems, has been to make a choice between the prioritising of the two roles of professional and parent (with many now

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choosing not to have children at all, or starting their families later in life), men, through flexible working options such as telework, are experiencing these feelings for the first time, and, it seems, they are less well equipped to deal with them. The fact that men are now inhabiting the painful ‘no man’s land’ that women have had to contend with, and which, even for them, a happy resolution has not yet been found, does not provide me with any satisfaction – rather it serves to highlight that telework can have anti-emancipatory outcomes as well as the emancipatory ones presented in the previous section, for both men and women.

In the previous section I announced as emancipatory, telework’s ability to enable women to engage in the labor market and men to engage more with their parental roles. Yet it is important to also consider the costs of these outcomes. For example, where both parents wish to prioritise their professional role, it could be argued that their children are starved entirely of parental attention, with only paid employees providing their ‘care’. And where working fathers neglect opportunities to earn extra money, it could be said that, again, it is his family who miss out by not being adequately supported financially. Indeed his whole job stability could be brought into question if he does not give this role sufficient attention. These are the potential downfalls of what can otherwise be seen as emancipatory movements, reminding us that emancipation is never entirely unproblematic.

A further example of the paradoxical nature of telework is that, even though one male participant found his increased role in family life beneficial for his wife, another found that his increased presence in the home had a negative impact on his. He described that she feels the need to take herself and their son out of their home during the day so that her husband can focus upon his work. This is a clear example of work coming to dominate the previously private realm of the home, and causing severe disruptions to family life. At one extreme, having men working from home can be experienced as liberating for their wives but, at the other, it can put extra strain upon women who desire to perform their parental roles in the same environment where their husbands are now performing their professional ones.

Overall it was clear from the data that traditional discourses are still prevalent and are still heard loud and clear by the participants – even by those making tentative steps toward crossing them. This suggests that there are costs involved and this was supported by reports that where men and women have traversed gendered boundaries, they are viewed with suspicion: the women, for example are viewed as lazy and neglectful of their parental roles; and the men are seen as deviant and indolent by not visibly fulfilling their provider role as fathers.

Conclusions

In sum, telework seems to have been an important catalyst in allowing (or forcing) these men and women to reconsider the priorities in their lives. A few notable cases of micro-emancipation are presented by the sample group, in particular where men ignore traditional constructions of fatherhood to fulfill caring parental roles, and where women leave behind traditional constructions of motherhood to focus upon their careers (though this is less

prevalent in this group). Despite only being very small steps in the process of liberation, as Sartre (in Billing et al 1988) points out ‘freedom is that small movement which makes a totally conditioned social being someone who does not render back completely what conditioning has given him (sic)’ and they therefore provide some optimism for the emancipatory potential of telework to have a real impact upon existing gendered social structures, as it destabilizes our current understandings and experiences of the realms of work and home by ‘fostering the sort of self knowledge and understanding of social conditions which can serve as the basis for such alteration’ (Alvesson and Wilmott, 1992). But as I have shown these examples are not without associated costs and paradoxes.

Following the research undertaken, it was possible to conclude that home-based telework can indeed provide a space in which men and women can embody roles and perform behaviors which are not considered traditional for their gender. Other researchers had previously asserted that this mode of working would benefit women by allowing them to pursue a career in addition to their traditional mothering role, but my research constitutes an original contribution to knowledge by asserting that men found their fathering roles were enhanced by having the opportunity to work from home. This contributes to previous understandings of flexible work, and will broaden the work / life balance debate by highlighting parenting as an issue for men as well as women.

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Telecommuting – In This Virtual World, What is Holding it Back ?

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Abstract: Telecommuting is a work method that is relevant to the Australian knowledge worker and technologist alike. For decades, commentators have extolled the benefits and growth potential of telecommuting in Australia. The high adoption rates once forecast have not been realised and the study reported here seeks to increase understanding of the inhibiting factors. This chapter addresses three issues in an effort to establish whether they are indeed inhibiting factors in the telecommuting adoption decision and if so, to what extent. These three issues are employee privacy, computer security and employee-employer trust. The analysis has prioritised and ranked the most important management concerns. Further analysis was then applied to test the relationships between the three concepts and the inhibition of telecommuting. The results indicate that four key issues are significantly and highly correlated to the decision to inhibit telecommuting.

Keywords: telecommuting, trust, privacy, security

Introduction

Telecommuting has a plethora of acknowledged advantages, if it is implemented in the appropriate business environment. These advantages can offer organisations, among other benefits, increased productivity [1] and the ability to recruit and retain the best employees [2]. Although telecommuting only affects a minor percentage of the Australian workforce, in an age of laptop computers, remote network access, and emerging wireless technologies, telecommuting is a work method that is expanding and growing in importance in the Australian workplace and information technology landscape.

Although numerous experts claimed that telecommuting was ‘the future of work’ arrangement, e.g. [3], the adoption of telecommuting practices has been slower than forecasted [4]. The contributing factors to this slow adoption have previously been identified as a lack of organisational awareness, and management inertia [5]. These have prevented most organisations from realising the many potential benefits of successfully deployed telecommuting programs.

Australia, along with many other countries, has been slow in adopting telecommuting arrangements. Australia has a high concentration of urbanized population in coastal cities and a high percentage of its well educated workforce is engaged in the services sector. The Australian environment is suitable to the use of telecommuting arrangements, however, has lagged other OECD nations in the level of adoption of telecommuting for some time [6].

With the advent of the wireless phenomenon, work conducted in wireless cafes, and airport hotspots is defined as telecommuting [7]. Such technologies are facilitating the growth and increasing the attractiveness of telecommuting to a new generation of knowledge workers.

With the availability of broadband technologies to homes in most industrialised countries, telecommuting is now, more than ever, an accessible and feasible work method for greater numbers of knowledge workers. For example in the past, professionals, such as architects, could not efficiently work from home using the available technologies (narrowband). Greater access to new technologies in the home is increasing the relevance of telecommuting as a work practice with potential to grow.

Telecommuting researchers have determined that management concerns are a significant constraint on the decision to adopt telecommuting [8]. This literature provided evidence and grounding that management concerns surrounding computer security, information privacy and employer-employer trust could be determinants in the decision to inhibit telecommuting.

Telecommuting trust researchers Harrington and Ruppel have called for additional research to be conducted in different contexts [9], and this research answers that call by reviewing the operationalisation of the trust constructs in the context of an Australian empirical study. The Harrington and Ruppel study was conducted only on information technology managers, whereas this research reports the opinions of managers from many functional departments.

1. Background

Management resistance to telecommuting adoption remains an issue in the Australian workplace. An Australian Bureau of Statistics [10] report highlighted that Australian managers remain hesitant about the adoption of telecommuting of subordinates. Employers not allowing telecommuting was cited as the second most common reason (14% of respondents) for employed persons not telecommuting more often (after the work not being suitable).

1.1 Security

Telecommuting security is cited in the literature as a known managerial constraint to the adoption, diffusion and success of telecommuting within organisations [11]. Gray et al [12] were one of the first telecommuting publications to discuss security in any detailed way. However, Gray et al do not analyze security in terms of whether it is a determinant factor of management's decision, instead security is treated as a practical consideration, along with

‘technology’, to be addressed once a person is approved to telecommute. More recent publications do, however, address security as a risk that is a part of every telecommuting arrangement.

For the purposes of this chapter, ‘telecommuting security’ covers both information security and physical security. The issue of information security includes data within the telecommuter’s home, and the information that is being transmitted between it and a corporate network. Physical security includes telecommuter’s hardware devices, and includes the possibility of theft and damage thereof.

A number of information security issues have been identified in the literature. A large proportion of information security issues are raised in the popular press, as the very subject matter of telecommuter computer and information security is a relatively new concept in academic literature. That said, an example of a information security issue covered in the literature is the complacency of management to rely upon corporate firewalls to nullify the risk of unauthorised remote access [13].

Another information security issue addressed in the literature is a deliberate interception of company data by competitors or any other unauthorised person [1]. In the hacker community, the type of attack whereby a virtual private network in use by a telecommuter becomes the platform facilitating an entry point, and the ability to compromise a corporate network is termed a ‘U-turn’ attack [14]. An Australian study found that there is a perception in the minds of managers that allowing employees to access a corporate database from a remote site, increases the risks of disclosure of commercial-in-confidence materials [15]. This research focuses on testing whether information interception has a relationship with the inhibition of telecommuting.

Another issue, or risk, of telecommuting identified by the literature is the theft of equipment from a telecommuter’s home [16]. An example used in the popular press of the high incidence of laptop theft, is in July of 2001, when the FBI announced that 184 of its 13,000 laptops were missing, and more alarmingly, that 13 of them had been stolen [17]. In an Australian study, results suggested that safeguarding of corporate assets in the home is a concern to management [15]. The issue of physical security involves a number of facets, and therefore a number of questionnaire items were included to canvas the various aspects.

Orlikowski and Barley [18] claim that there is a distinct lack of research of the impact of new technologies on the adoption rate of telecommuting. This study goes some way to addressing the issue by including a number of questionnaire items that aim to ascertain the relationship between telecommuting and the security authentication devices, security tokens, and password protection.

Although not covered in the literature to the extent of other telecommuter security issues, security and legal liability issue were deemed relevant for this research, as they are likely to impact management attitudes towards telecommuting. Telecommuting can present legal issues, for example a scenario where family members use a corporate PC to download sexually explicit or illegal materials. This is not a completely fictional scenario, in California, an employee used corporate hardware to access illicit material in his home and was dismissed under Californian law (*Insurance Services Corp. v. Superior Court of Los Angeles County*, 2002). Another physical security issue that this research seeks to

understand is the security and liability issue of viruses or worms entering a corporate network via a telecommuters remote access point.

1.2 Privacy

Surveillance and monitoring is a method for the manager to maintain control over subordinates, through the collection of objective data on employees, rather than relying on personal relationships [19]. Computer based performance monitoring allows managers to monitor telecommuting employees in great detail, and the availability of technology based access may even lead decision makers to seek out information they would not have asked for in person [20].

Both physical and information privacy are telecommuter related issues, as the line between work and home blurs. Employer management boundaries are untested and it is unknown, for example, whether an employer can legally enter an employee's home to inspect workplace safety or security measures.

The issue of telecommuter privacy is a trade-off between the legitimate needs of an organisation, and the fundamental right of an individual to privacy. Spinello [21] argues that if a corporation has legitimate suspicions that an employee is using its systems for untoward or frivolous reasons, then the corporation should investigate. However, when there is no such suspicion, the possibility of the abuse of corporate systems should not outweigh the reasonable expectation of employees to be trusted by their employer. Employee privacy is related to the issue of the loss of direct control that many managers are uncomfortable relinquishing [22].

1.3 Trust

The concept of trust is one that has recently received much attention in the information systems and decision science arena, and researchers are endeavouring to model all possible dimensions of trust [23]. This study looks specifically at employee-employer trust in the context of a telecommuting adoption decision.

The telecommuting literature suggests that a lack of trust is a management attitude that influences telecommuting because it is believed that managers cannot manage what they cannot see, or that out of sight, employees will engage in opportunistic behaviour [9, 24, 25, 26]. It is well documented in the telecommuting literature that the supervision method used by management has a relationship with the adoption of telecommuting. The vast majority of studies strongly correlate visual management, otherwise known as traditional management with the inhibition and failure of telecommuting initiatives.

The ability to see, or inspect workers is used by managers as the input to the productivity equation [27]. Thus traditional management see the need for direct personal control of employees because of a lack of trust in the employees and the assumption that employees need to be motivated by an office environment [28]. More importantly, management opposition to telecommuting is believed to be based on this more traditional lack of trust of employees [9, 24, 26, 29]. Trust of the employee also extends to the custodianship of organisational assets, such as laptop computers.

There is little research on the impact of managers' trust of potential and existing telecommuters, and its effect on the decision to allow telecommuting [9]. Perin [27] interviewed professionals and their managers to understand why, although organisations would allow telecommuting, the professional employees were not participating in it. While the focus of the study was on the professionals themselves, Perin found that the need for employee presence, visibility of hours worked, and punctuality lead to distrust on the part of management and the reluctance of the interviewed professionals to participate in telecommuting options [9].

1.4 Objective

The objective of this study was to firstly rank the importance of the three concepts of security, privacy and trust, and during this analysis to gain an understanding of what issues have highest importance to of managers; then to assess whether these factors were inhibiting the take-up of telecommuting.

2 Methodology

A survey instrument was developed and piloted in a small-medium sized organisation, and the instrument was refined. The improved instrument was then piloted in the main study organisation and was used for "test-retest" purposes. The modified (and final) survey instrument was then distributed to managers and employees in the main study organisation. Face validity was established in the demographic questions by adapting relevant demographic questions from a validated telecommuter study by Belanger [30]. Belanger based her demographic questions on research by earlier telecommuting researchers who identified particular demographic groups as having an impact on data results, for example, job title. Face validity was further established by using expert researchers as evaluators, as the more experts who agree that the questionnaire does indeed measure what it claims to measure, the greater the level of face validity [31]. A further advantage of conducting face validity tests with an expert sample is that they are able to critique some of the external validity issues associated with the questions presented [32].

The main study was completed in a large Australian telecommunications organisation. The researcher was placed at the organisation for a six month period, whereby, access to research subjects was facilitated. Working within the organisation which is the sole subject of empirical research has certain limitations (see later).

Research participants were all Sydney based knowledge workers and were full-time employees of the main study organisation who performed roles in a variety of areas including IT, marketing, sales, operations and legal. Managers and employees across all functional departments in the organisation were randomly selected. The randomisation was achieved by picking names from organisational charts. The survey distribution method was hand-delivery, as pilot studies had illustrated that this method achieved high response rates. The response rate for the main study was 69% (n = 86).

Cronbach alpha scores for the three constructs of security, privacy and trust were all above .6, so can be considered acceptable [33]. The procedures followed give considerable support to the external validity of the findings from this study. These include the selection of respondents from the main study organisation, almost all of whom were knowledge workers engaged in full-time employment; the randomisation of survey distribution; the selection of respondents from a wide range of functional departments, and performing jobs where some form of telecommuting was possible; a high response rate for survey-type research; potential survey respondents had no obligation to their organisation, their manager, or the researcher to complete the survey; and anonymity.

3. Results

The analysis used to rank the relative importance of the three issues was the non-parametric Mann-Whitney mean rank test. The grouping variable was managers and non-managers, and the variables were the ranks given to the survey questions by the participants.

For the sample of managers, the lowest mean rank (and hence the most important issue) was trust, followed by information security, physical security and the least important issue was privacy. It is important to note that the statistical significance of the mean ranks was quite poor, hence the means ranks are not reliable and conclusions should only be drawn in general terms. .

When the questionnaire items that are most strongly correlated with the inhibition of telecommuting are singled out, we were left with four issues, all of which are statistically significant. Two of the questions are privacy related, and the remaining two questions relate to security and trust respectively. It is valuable to concatenate these issues, and measure the influence that they have on the inhibition of telecommuting. The resulting statistic would be an indication of the importance these three issues have on the decision to inhibit telecommuting.

Multiple (linear) regression was used to analyze these four issues against inhibition – the resulting R^2 score is 0.38. This R squared score is significant to the 0.001 level, and has a high F score (6.13), both of which indicate a high level of statistical significance. This result indicates that 38% of movement in the decision to inhibit telecommuting can be explained by movement in the four key issues - which relate back to security, privacy and trust. This is a high level of correlation, and the result indicates the key importance of the four issues, namely:

- The availability of computer authentication tools for telecommuters, such as tokens [computer security]
- The unauthorised use of personal information that relates to telecommuters [employee privacy]
- The ability and right of management to control and monitor telecommuters via hardware, and its contents [employee privacy]
- The level of trust management have that their employees have an adequate level of expertise to cope with telecommuting and new technologies [employee-employer trust]

Work-Life Balance

This finding indicates the strength of the relationship between the four key issues and managers' inhibition propensity. It also demonstrates the four key issues are indeed significant determinants in the telecommuting inhibition decision.

Discussion

Managers regard the complex issue of trust as the most important concept. And, while regression analysis showed that the three issues have a poor level of statistical significance when they are treated as individual and independent concepts, when the analysis was more comprehensive, and addressed each questionnaire item individually, some interesting results emerged.

First, it was found that a number of key issues existed within each concept. These key issues were both statistically significant, but also statistically important to (a) the comfort level of telecommuters and their managers, and also to (b) managers' decision to inhibit telecommuting.

The multiple regression revealed perhaps the most important finding of this research - the combined importance of the key issues when they were measured against the inhibition of telecommuting. A high 38% correlation between the key issues of security, privacy and trust and telecommuting inhibition is a result which not only justifies research in this new arena, but also reinforces the importance and practical significance of the three emerging issues in the telecommuting decision.

The issues of computer security, employee privacy and employee-employer trust are emerging issues, which are growing in importance as new technologies facilitate greater use of telecommuting. These new technologies, such as broadband internet and wireless networks, introduce a new set of telecommuter security and privacy concerns that were previously of no consequence. Today, computer security and trust are major areas of information systems research, and hence are of high importance in the telecommuting area. Prominent telecommuting researchers have been calling for additional research in the area of telecommuter trust, and this study goes some way to answering such calls.

There are limitations to this work – the sample size was small, the study was conducted in just one organisation, the researcher was placed there, there are the normal concerns with survey based research and the survey results are at a particular period in time.

Nevertheless, this empirical research contributes to the literature by increasing understanding of the Australian manager's attitudes towards inhibiting telecommuting. Through understanding management concerns around computer security, privacy and trust concerns, regulators, governments, technologists and telecommunications organisations are better able to tailor campaigns and drive adoption of telecommuting in Australia.

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Human Resource Management Practices

Requests For Telecommuting: Exploring Managerial Decision Making*

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Abstract: In the present study, three dimensions of the employment relation (governance relationship; exchange relationship; co-operation agreement) are distinguished that enable to analyze managers' telework attitudes underlying managers' telework decisions. The present study questions what related (control and coordination, commitment and trust) arguments managers put forward when judging telework practices in their departments and what factors influence their attitudes towards employees' individual telework requests. The respondents in this study are 65 managers in 6 organizations in the financial sector, in 3 countries (NL, UK and Sweden), who are in the position to judge telework requests. A combination of interviews and a vignette-study is chosen as it allows looking into managers' attitudes (and decision-making) in real and experimental (but realistic) situations. Managers' attitudes vary from very positive towards very negative, regardless of their organizations having formal telework arrangements. The study shows that managers view the employment relation primarily as a governance relationship, emphasizing the importance of coordination and control. They have more favorable attitudes towards higher educated workers often being rewarded on the basis of output. Moreover, managers have more favorable attitudes towards employees with specialized knowledge which underlines the commitment argument. However, managers also view contextual performance, like coaching others and learning on the job, part of the exchange relationship which restricts telework. Finally, workers who perform well in the regular work situation are more trusted to telework. Some managers express distrust in teleworkers. In all cases, telework is an 'idiosyncratic deal', rather than a benefit that is accessible to all workers.

Keywords: vignette study; interviews; telework requests; managers' attitudes.

Introduction

In order to create surplus value and to remain economically successful, human resource management has started to radically redefine her role in the organization. Next to the trend of HRM-policy becoming part of organizations' general and strategic policies, more

* Draft version August 2006. Please do not quote.

attention is being paid to employees as human resources and to employees' personal needs [1]. Social sustainability in organizations [2, 3] presumes a balance between the aims of the organization and that of their employees [2, 3]. One way to meet the needs of both the company and that of its employees is 'home-based telework', in the US often referred to as 'telecommuting'. In the European context, working at home part of employees' contractual working hours instead of commuting to the office is a growing work practice [4]. Since its introduction in the 1970s and 1980s, the total amount of European telework (in a broader sense) has increased to around 9 million in 1999, i.e., 6% of the European workforce [5]. Telehomeworkers dominate the broader category of teleworkers that also includes mobile workers and self-employed workers [4]. In the present study, the focus is on telehomeworking and will be referred to as telework.

Employees may be attracted by teleworking because of more flexible working hours, the reduction of commuting time, more time for home and family, a better work concentration or greater job autonomy (empowerment) [6, 7]. Employers may have introduced telework as a solution to problems of housing expanding staff, as a means of reducing overheads, or to increase productivity and flexibility. Moreover, it can be seen as a way of attracting and committing valuable personnel. As such, teleworking can be viewed part of high-commitment, high-trust or high-involvement work systems [8, 9, 10] that aim to manage contradictions of control and consent.

At present, the demand for telework among employees goes beyond the access that has been given to them [4,11, 12]. To understand this imbalance, it is important to study what factors facilitate the adoption and diffusion of telework practices at the organizational level. In this chapter we focus on one major bottleneck for the further uptake of telework practices in firms, i.e., managers' attitudes towards teleworking as it informs managers' telework decision-making [13, 15]. In many cases, employees' access to telework largely depends on individual managers' discretion, even when formal telework policies are present. (Human resource) managers may feel that telework benefits employees more than the company [15]. In this respect, we should bear in mind that managers experience dilemmas related to balancing their interests as a manager and their subordinates' needs. Being rewarded on the basis of (often short term) economic performances of their business units, employees' work-life balance, for example, (which may be improved through teleworking) may not be managers' prime concern [16]. Despite current writings on the modification of traditional managerial roles, managers and direct supervisors may still feel uncomfortable with remote work and prefer their employees to be on-site.

The 'managerial dilemma' draws our attention to the various dimensions of the employer-employee relationship (manager-employee relationship), i.e., the way human resources are organized in the light of productive aims of the firm, meanwhile taking the aims of employees into account [17]. Three strongly interrelated dimensions of the employment relation can be analytically distinguished [1]. First, the employment relation implies a managerial or *governance relation*, i.e., the employment relation gives a manager, as an agent of the employing organization, the right to manage subordinates. Second, the employment relation can be viewed as a market or an *exchange relation*. The exchange relationship does not only concern the exchange of time for pay, but also other psychological contract terms, i.e., the explicit and implicit expectations of both the manager

and the employee about the work to be done (tasks, responsibilities, work conditions, et cetera). Third, the employment relation can be viewed as a *co-operation agreement*, as it assumes that a manager can trust their employees to co-operate in line with the interest of the organization despite of conflicting interests.

In consideration of the (supposed) transformation towards a sustainable organization, the present study aims to explore what (coordination and control, commitment and trust) arguments play a role in present-day managers' views on telework and how these relate to factors influencing managers' attitude towards employees' concrete telecommuting requests. The research question is twofold:

- What kind of arguments do managers put forward when judging telework practices in their departments?; and
- What factors influence managers' attitudes towards individual workers' concrete telework requests?

In the present study, we aim to contribute to the existing research literature in several ways. First, in this chapter we study both managers' general telework attitudes and their attitudes towards concrete requests of employees asking permission to work at home (occasionally for a day). This may shed light on why telework is more often chosen as an *ad hoc* strategy to cope with (structural or incidental) work and household demands, rather than being part of an organization's strategic policy. Second, telework research has often been criticised for not being focussed on theory-building, or on testing theory-driven hypotheses [14]. The present study combines various theoretical perspectives that relate to the way the employment relationship can be viewed (Section 2), meanwhile using insights from the existing telework literature. Our theoretical framework can be used both in an explorative way, but also helps to formulate testable hypotheses. Third, the present study combines two methodologies (Section 3). Through face-to-face interviews, managers are inquired after their experiences with and attitudes towards telecommuting in their department. In addition, managers are asked to respond to vignettes presenting fictitious, but realistic telework requests of their employees. The combination of methods allows us to draw conclusions regarding managers' general attitudes to teleworking and factors that affect these attitudes in concrete request situations. Moreover, the vignette study allows us to use multivariate analyses, and hence, to test hypotheses simultaneously. Finally, fourth, the results of this study (Section 4) may either support or tackle assumptions about managers' telework attitudes.. It gives insight in how the ongoing shift towards social sustainability in organizations does or does not affect managers' telework attitudes (Section 5) by presenting management and contextual conditions that stimulate or hinder the uptake of (formal and/or informal) telecommuting arrangements.

The respondents in this study are managers in 6 employer organizations in the financial sector (2 public and 4 private organizations) who are in the position to judge requests of employees to telework. Although the data are collected in 3 European countries (Netherlands, United Kingdom and Sweden), a cross-national perspective on managerial decision-making regarding telework is not the prime focus of this study. The three countries included in this study all have – compared to other countries – a relatively large share of teleworkers and relatively well-developed telework policies. As managers in these countries

are quite familiar with telework practices, they are an interesting case to study the relative influence of the different types of arguments in managerial attitudes concerning telework.

1 Theories and hypotheses

In the Introduction, three dimensions of the employer-employee relationship were introduced that can inform managers' attitudes towards telecommuting in general and their attitudes towards employees' concrete telework requests. These three dimensions relate to coordination and control issues (governance relation), commitment (exchange relation) and trust issues (co-operation agreement), respectively. In this section, the theoretical framework that will be used to investigate the role of these dimensions in managerial attitudes towards telework will be elaborated upon. First, we will describe the role of coordination and control. Second, we will outline the role of commitment in managerial attitudes towards home-based telework. Third, the role of trust in telework practices will be described. Finally, we will conclude this section with an overview of the hypotheses that will be tested in the quantitative part of this study (vignette study).

1.1 Governance relation: the role of coordination and control

As was noted earlier, a managers and employee are engaged in a governance relation: the manager is in the position to control the work done by his/her subordinate and to manage him/her. According to the transaction cost theory [18], any employment relation entails a particular 'problem potential'. The reduction of the problem potential to an acceptable level involves management costs [19]. The magnitude of these so called 'transaction costs' depends on the size of the problem potential. On the one hand, the problem potential depends on the odds and consequences of predictable and unpredictable contingencies (*coordination problems*); on the other hand, it depends on the odds and consequences of opportunistic behavior of the trustee (*control problems*) [19]. Since transactions with a higher problem potential induce more management costs, organizations will be more likely to choose for a more hierarchical governance structure that allows for closer coordination and control.

With respect to managers' attitudes towards teleworking (and, ultimately, the decision to give employees access to teleworking), managers will be led by the problem potential of teleworking, and hence by the associated costs [20]. As employees work physically away from the department (part of the time), traditional control principles like direct supervision or behavior control become increasingly difficult [10], although not necessarily impossible with the use of ICT. However, employees working at a distance are still involved in the employment relation with their manager. A straightforward application of transaction cost theory to our research problem would suggest that a high problem potential of a certain employment relation implies that a manager is less likely to allow an individual employee to telework. However, the decision to allow telework can be viewed as a new contract added to an existing employment relation. The existing problem potential of this employment relation has been reduced or accepted already. In order to understand

differences in managers' attitudes towards teleworking in their departments and variations herein across subordinates, we should rather consider the *additional* problem potential associated with teleworking, as managers will probably be more inclined to allow telework when the (perceived) additional problem potential of telework is relatively low.

Managers may be more reluctant to allow teleworking when severe coordination and control problems are more likely to arise. Existing coordination and control problems are even assumed to accrue when work is performed at a distance (the 'telework risk'). The extent to which these problems arise depends on the chance that telework will disrupt the conduct of work (of the manager, the teleworkers, or his/her co-workers). The disruptiveness theory, developed by Powell & Mainiero (1999), elaborates on this type of risk. In line with this theory, it can be assumed that teleworking makes managers' jobs more complex and difficult because they are not sure whether the necessary work gets done and how the work is done. In other words: telework makes managers' jobs more complex due to the coordination and control problems that arise. As managers are responsible for the performance of the department they manage, and are often rewarded primarily for the results they achieve in their work units rather than for the concern they demonstrate for their employees' work-life balance for instance, managers will take the disruptive consequences of the telework practice for the department into account when judging telework practices in general, or judging a concrete telework request. Given the additional demands telework places on managers, managers may be unwilling to grant telework requests unless they believe that granting the requests will cause little or no disruption to the conduct of their work or the work of their subordinates, and will not lead to additional coordination and control problems. An increase in coordination and control problems will particularly occur in case organizations have no formal telework policy, i.e., that are not formally supporting teleworking, and, where there are little incentives or rewards for managers to allow teleworking.

Several factors are expected to influence the degree to which a manager will view a subordinate's telework request as disrupting and, hence, resulting in additional coordination and control problems, namely: a) how frequent an employee wants to work at home and the reason the employee puts forward when making the telework request, and b) the nature of the tasks, skills and responsibilities of the subordinate who is making the request. The telework frequency matters, since occasional teleworking practices are less likely to disrupt (the manager's, employee's and co-workers') work activities compared to full-time teleworking practices. Moreover, when employees want to work from home because of work-related reasons, like finishing work in order to meet a deadline, or to work on a particular task that needs to be done in isolation, a manager might be more inclined to grant a request compared to personal reasons or issues as, in the former case, telework likely serves the performance of the department directly.

Next to the type and reason of request, the nature of the tasks, skills and responsibilities of the worker who is making the request are important. Some type of job activities demand frequent and often unpredictable contacts between co-workers, managers or clients. When workers highly depend on each other's input, knowledge and skills, i.e., when their assistance is required often, employees need to be accessible. Teleworking may easily lead to a loss of communication, accessibility, feedback and information exchange.

The coordination problem will also depend on the extent to which activities can be planned. Unexpected contingencies, like rush jobs, can disturb the work process, often requiring managers and individual workers to reorganize their work. Especially when employees have supervisory tasks, the potential coordination problem can be severe. Telecommuting may not only affect their job performance, but also that of their subordinates. Especially since it is their job to facilitate, coordinate, motivate and control the work of others, their physical absence will bring about problems, such as challenging opportunistic behavior of subordinates, or failing tasks due to a lack of supervision and feedback. In previous research, most managers also preferred to be available to their employees and, therefore, tried to be at the office during normal working hours [10].

So requests of people with supervisory jobs can be considered more disruptive, since managers generally rely more on these employees to achieve results (because they are responsible for the work of others as well as their own work). Additionally, employees who have specialized skills generally will be more needed in the work place than others. These employees contribute relatively more to the performance of the department than employees with less critical skills, and therefore, their use of the telework opportunity will cause more work disruption. Moreover, opportunistic behavior of these workers resulting in poor performances also has a greater impact on the department's performance.

When it comes to certain work activities, controlling the work process directly is always problematic, regardless of whether the work is being performed at the regular workplace or at home. The additional risk associated with telework may therefore be relatively small. High-grade knowledge work, for example, requires intense levels of concentration and creativity that cannot be enforced by strict, direct control. This type of work requires a certain amount of freedom. Close supervision may even affect creativity and productivity negatively. Besides, even in a regular workplace situation, certain job categories and individual employees are used to a high degree of freedom. Their sovereignty may apply in terms of scheduling freedom ('when the work is done') or degree of job control ('how the work is done' in terms of order, method and speed of doing things). With job categories and individual workers that have more time sovereignty and job autonomy already, employers always face a high, but obviously acceptable, trust problem. Also mobile workers performing their tasks away from the regular workplace, sometimes using online connections during business trips or in the field, experience a relatively high level of freedom. When the existing direct control problem of job categories and individual workers is reduced by exercising output control – meaning that they are controlled and rewarded on the basis of their results (task orientation) rather than on actual 'face hours' at work (time orientation) – the additional risk potential of telework is relatively small.

Summarising, managers are expected to have a positive attitude towards teleworking and judge an employee's telework request more positively when the anticipated (additional) coordination and control problems are lower. The (additional) coordination problems are considered lower when the assistance of the employee is not often required, when the work activities can easily be planned, and when he/she has no supervisory tasks. The (additional) control problem is considered lower when a subordinate has more time sovereignty and job autonomy in his/her current job situation already. In addition, when the existing direct control problem can be reduced by exercising output control, meaning that employees are

controlled and rewarded on the basis of their results (task orientation) rather than on actual 'face hours' at work (time orientation), the additional risk potential of telework is considered as relatively small [20].

1.2 Exchange relation: the role of dependency and commitment

A second dimension of the employment relation between manager and employee is the market or exchange relation. Next to the exchange of time for pay, it also involves other psychological contract terms. The 'psychological contract' [21] refers to the mutual expectations that the employer and the employee have concerning the employment relationship. In this relationship, the expectations - that are often subjective, implicit and dynamic - should be in balance. Highly valued workers, like highly educated workers, offer their knowledge, skills, experiences, flexibility and intentions towards life-long learning in exchange for a good salary, interesting work, job autonomy and, increasingly, (time-spatial) flexibility. Not meeting an employee's expectations, in our case, not granting the employee's telework request, may damage the psychological contract as experienced by the employee. As a consequence, the employee will be less motivated and committed and reduces his/her extra-role behavior. The employee may even end the employment relationship when the psychological contract terms are met elsewhere. In other words, managers' telework attitudes and telework decisions regarding a telework request may affect employees' organizational commitment [22], and, ultimately, turnover intentions [9]. In the same vein, when an organization or manager does grant the telework request, the employee is expected to feel more committed to the organization. Commitment is of vital importance for managerial control as it stimulates workers to act in accordance with the organizational needs and, hence, replaces direct control mechanisms [10]. The increase in freedom and autonomy associated with manager's telework is often viewed as a privilege and is, therefore, highly valued by workers. Moreover, the freedom (trust) that they are given fills teleworkers with a certain pride and prestige (*ibid.*). Especially when employees are highly valued, damaging the psychological contract may affect commitment, and hence, harm the performance of the department in the short or long run and, ultimately, the organization as a whole.

Granting telework requests may, therefore, be particularly important in case it concerns requests of highly valued workers. Managers are more dependent on these employees compared to other subordinates, and will, therefore, be more inclined to increase these workers' commitment by allowing them to telework. To say it otherwise: a manager's attitude towards an employee's telework request depends on the degree to which the manager depends on this employee for the performance of his/her department [23]. This dependency increases as the contribution of the employee is higher. More dependency gives an employee more negotiation power, not only in salary negotiations, but also regarding the use of telework policies, for example. The negotiation power of employees is especially high when the subordinate's knowledge or skills make him or her difficult to replace. The more difficult it is to replace an employee, the more the manager 'depends' on this employee for the performance of his/her department, the more power this employee has in negotiations and the more likely it is that managers are well-disposed towards teleworking.

It is assumed that employees with no or few critical skills are easier to replace than employees with critical skills. Note that this expectation is opposite to what we would expect on the basis of coordination and control arguments, on the basis of which one would predict that managers will be more *negative* towards requests of subordinates with specialized skills that are difficult to replace within their department. The exchange dimension of the employment relation makes it important for managers to ‘cherish’ the human capital in their department in the longer run, whereas the governance dimension draws the manager’s attention towards managerial cost arguments concerning the organization of work in the short run.

Not only ease of replacement matters for the dependency relationship between manager and employee. Another relevant factor, according to Klein et al. (2000), is the ‘dependency threat’. Dependency threat refers to the likelihood that the subordinate will leave the organization if the telework request is not fulfilled. Depending on the situation on the labor market, the pressure of such treats can be strong or weak: in a tight labor market, managers depend more on their employees, since it is more difficult to find suitable replacement and it is easier for employees to find another suitable job in the labor market, or to start-up one’s own business.

1.3 Cooperation agreement: the role of trust

The third dimension of the employment relation refers to the *co-operation* aspect of work in which mutual trust plays a vital role [24]. In case of teleworking, managers have to trust their employees that they will actually do the necessary work at home in an adequate matter and not devote work time to domestic chores, as total control is too costly, if possible at all. It is quite difficult for managers to know whether or not one can trust an employee when working at home. Therefore, managers will use ‘signals’ to assess the degree to which an employee can be trusted to telework and still adequately meet the demands of the manager and contribute to the performance of the department. These signals generate trust in the employment relationship.

One of these ‘signals of trust’ is ‘social similarity’ [25]. One can speak of ‘social similarity’ when a manager and employee are similar with respect to relevant social characteristics, such as sex, status and ethnicity. It is often assumed that individuals sharing social characteristic share comparable norms and values [26, 27, 28, 29, 30]. Moreover, research indicates that, besides the signaling function of social categories, similarity of social characteristics is an important basis for interpersonal attraction [31]. To say it otherwise: social similarity increases mutual liking, generates trust and enhances influence. Social similarity also plays a role in management decisions as managers often use social information [32]. Research indicates that social similarity between manager and employee enhances less critical evaluations as well as greater reciprocity [33].

Trust can also be generated by social embeddedness [34]. Managers’ telework decisions are embedded in an existing employment relation. A long-term dyadic embeddedness, may imply that, on average, employees can be considered more trustworthy and thus more likely to be allowed to teleworking. The dyadic embeddedness has two components: the history of the current work relation (often referred to as the ‘shadow of the

past') and the future expectations ('shadow of the future') [19]. A longer work history provides employers the opportunity to judge better whether an individual is suitable for telework [35]. People who are working for the company for a longer time already have built up a strong organizational commitment [10] and are more familiar with the organizational culture which can also function as a (meta) control mechanism [36].

1.4 Hypotheses

The hypotheses mentioned below are derived from the theoretical framework presented in the previous sections relating to the three dimensions of the employment relationship. These hypotheses will be tested in the quantitative analyses that are part of this study. Note that hypothesis 1c contradicts hypothesis 2b and that hypothesis 1d equals

Governance relation: coordination and control

Hypothesis 1a

Managers will be more positive towards teleworking (requests) in case their organization has a *formal telework policy* (and supports the telework practice through the required information and communication technology).

Hypothesis 1b

Managers will be more positive towards teleworking (requests) in case they the employee has *no supervisory tasks*.

Hypothesis 1c

Managers will be more positive towards teleworking (requests) of *employees who have no specialist knowledge and skills that are difficult to replace* and that can be more easily missed in the workplace.

Hypothesis 1d

Managers will be more positive towards teleworking (requests) in case they manage workers that are *higher educated* and are used to greater autonomy.

Exchange relation: dependency and commitment

Hypothesis 2a

Managers will be more positive towards teleworking (requests) of *higher educated employees* as they add more surplus value to the company.

Hypothesis 2b

Managers will be more positive towards teleworking (requests) of employees who have a lot of specialist knowledge and skills that are difficult to replace than they are towards requests of employees with no specialist knowledge and skills.

Hypothesis 2c

Managers will be more positive towards an employee's teleworking (request) when *the labor market is tight*.

Co-operation agreement: trust

Hypothesis 3a

Managers will be more positive towards teleworking (requests) of employees who are *similar* to them on the basis of relevant *social characteristics* (in this study, gender and education).

2 Data and methodology

2.1 Research design

The data reported in this chapter are part of a cross-national study on the implementation and utilization of work/life policies within the European workplace. One of the policies included in the study was the possibility of working from home. Managers from 6 organizations in the financial sector in the Netherlands, the UK and Sweden participated in the study: two private companies (bank (bank.NL) and consultancy firm (Fincom.NL)) and one government agency (Service.NL) in the Netherlands; two financial firms in the UK (insurance company (Insurance.UK) and consultancy firm (Fincom.UK)); and a government agency in Sweden (Service.SE). These are all large organizations with 1,500 or more employees.

In each organization approximately ten managers were interviewed and asked to participate in a vignette study. Only in the British insurance company, no in-depth interviews with managers were conducted. In this case, a vignette study was accompanied by a written questionnaire. Managers who had the decision-making authority to approve or reject a request to work from home were selected to participate. The selected managers supervise different types of departments within their organizations.

In the in-depth interviews, managers were asked 1) about their personal experience with working from home; 2) whether any of their subordinates work from home; 3) what their attitudes are towards people working from home; and 4) how telework practices are organized. Their responses were listed in a table which enabled systematic analysis of the data.

Box 1 Example of a vignette: a hypothetical situation in which a fictitious employee submits a request to work occasionally a day from home

A male employee in your department with a supervisory position asks whether it is possible to work occasionally a day from home. This employee has a lot of specialized knowledge and skills that are not easily replaceable within your department. At the moment the request is submitted, there is a tight labor market and it is difficult to get new people.

At the end of the interview, each manager was asked to consider 3 vignettes, i.e., hypothetical situations in which fictitious employees submit a request to work from home occasionally for a day. For each fictitious employee the vignette described 1) whether the employee was a man or a woman; 2) whether the employee had a supervisory position; 3) whether the employee had much or little knowledge and many or few skills that are difficult to replace, and; 4) whether at the moment the request was submitted there was a tight or relaxed labor market. Box 1 shows an example of the vignettes presented.

The managers were asked to express their attitudes towards the request as presented in the vignettes (by giving a mark). When assessing the vignettes, managers had to have the most common educational level of their subordinates' job in their department in mind. The most common educational level (job level) the manager had in mind was also inquired after by the interviewer.

It is important to note that a difference between the in-depth interviews and the vignettes is that in the interviews, managerial attitudes concerning more structural forms of teleworking were discussed, while the vignettes all refer to working at home occasionally for a day, i.e. teleworking on a much less structured basis.

Note that not all organizations had a formal telework policy at the time of the research. The Dutch consultancy firm (Fincom.NL) had a formal telework policy in case employees would like to work from home on a regular day every week. When this policy is granted, employees receive part of the costs involved in arranging a workplace at home through a specific tax arrangement. In addition, this firm made it possible for workers to work from other offices in the country when needed by offering an infrastructure that allows people to log in on the network and use flexible office space in other locations than their regular workplace. The Dutch government agency (Service.NL) had no formal telework policy in contrast to its Swedish counterpart (Service.SE). The Dutch banking and insurance company (Bank.NL) had no formal telework policy although they were experimenting with a mobile telework centre. The British insurance firm (Insurance.UK) had no formal telework policy either. The consultancy firm in the UK (Fincom.UK) did allow for telework contracts.

2.2 Method

In this chapter, we will first analyze the interview data on managers' attitudes towards telework and their experiences in their departments in order to assess their general attitudes towards teleworking, and the arguments they put forward to ground these attitudes. The

vignette-study data allow us to actually test some of the formulated hypotheses statistically by estimating hierarchical linear models [37]. We chose this type of model because of the multi-level structure of the data (i requests, ‘nested’³ in j managers).⁴ Because hierarchical, linear models are based on two independent populations (and random samples), the number of units at both levels should be sufficiently large. The rule of thumb is that the highest level (in this case that of the manager) must amount to a minimum of 20 units of analyses [37]. The models were estimated for managers (i.e., 65 managers, assessing 195 unique requests).

The vignette design offers some major advantages for the study of managers’ attitudes regarding the use of work-life policies in their company. In ‘real life’, managers may not be confronted very often with employees’ telework requests (see also Klein et al., 2000). Especially managers that have a (slightly) negative attitude will not face these request very often, since managerial’ attitudes also influence the requesting behavior of their subordinates. For example, if a manager has a very negative attitude towards the use of telework policies, his or her subordinates might hesitate to pose such request because of fear of rejection or because of potential negative career consequences. A vignette design offers the possibility to investigate managers’ attitudes concerning a relatively large number of realistic requests.

2.3 Operationalization

In the quantitative analyses, the following variables will be used to test the hypotheses that were presented in Section 2.4:

- 1) Managers’ *attitude towards the employee’s telework request as presented in the vignette* (the dependent variable, measured on a scale from 1 (= not positive at all) to 9 (= very positive);
- 2) Presence of telework policy (Hypothesis 1a);
- 3) Supervisory position of the employee doing the request (Hypothesis 1b);
- 4) Employee doing the request has specialized knowledge and skills that are difficult to replace (Hypothesis 1c, Hypothesis 2b);
- 5) General educational level of the manager’s subordinates (Hypothesis 1d, Hypothesis 2a);
- 6) Labor market situation at the time of the request in the model (Hypothesis 2c).
- 7) Similarity between the manager’s and their subordinate(s) gender and educational level (Hypothesis 3a).

³ A ‘nested’ data structure means that one unit at the lower level (i) falls under one unit of the higher level (j). For the present study, this means that each request is assessed by only one manager (no two managers ever assessed the same exact request), given that each manager was asked to keep in mind the characteristics of his/her own department as well as its most common function when looking at the requests. Since each manager works at a different department, this means that all requests are ‘unique’.

⁴ With ‘regular’ regression models, the fact that this involved two (independent) populations – one of managers and one of requests – would be ignored [38]. Regression models ignore that the data comprehend several levels and the n is overestimated, thus increasing the risk of concluding that there are significant effects of manager characteristics on the assessments of different requests, while in reality there are no such effects (Type I error).

Control variables

In addition to the variables that were selected on the basis on the theories discussed in Section 2, three control variables are added in the statistical analyses. First, it can be assumed that the gender of the employee submitting the request influences the judgment of managers. In some studies, significant differences are indeed found in judgments of managers regarding requests of male and female employees [23], but this is not unrefuted [16]. With respect to telecommuting, men's actual telework practices outnumber women's. Moreover, men are more likely than women to have access to telework, despite them being in the same work and household situations [20].

Table 1 Descriptive statistics of manager and request characteristics
($N_{vignettes}=195$ requests, $N_{managers}=65$)

Variable	N	Min value	Ma x value	Mean	S.D.
Attitude towards request	195	1	9	6.15	2.12
Dummy variable: organization has a telework policy	195	0	1	0.52	0.50
Dummy variable: government organization	195	0	1	0.31	0.46
Dummy variable: work in department requires high education	189	0	1	0.62	0.49
Dummy variable: manager is a woman	195	0	1	0.37	0.48
Dummy variable: employee is a woman	195	0	1	0.51	0.50
Dummy variable: employee has a supervisory position	195	0	1	0.53	0.50
Dummy variable: has specialized knowledge/skills	195	0	1	0.57	0.50
Dummy variable: labor market is tight at time of request	195	0	1	0.52	0.50
Dummy variable: manager and employee are of the same sex	177	0	1	0.49	0.50
Dummy variable: manager and employee have the same education level	177	0	1	0.81	0.39

Second, a dichotomous variable for governmental organization is included in the analyses, as not only formal but also informal telework policies may differ across sectors. Third, also the manager's gender is included in the analysis as male managers may have other attitudes towards teleworking than female managers. We do not control for national context, as we have relatively few organizations per country. As we only have one Swedish organization, there is no variation in telework policy within this country, and, hence including a country variable next to the telework policy variable makes no sense.

Table 1 presents the descriptive statistics of the relevant variables that are included in the quantitative data set.

3 Results

3.1 Telework practices

Some managers have personal experience with working from home themselves although, generally, they limit their time away from the central office. As a manager they feel that they need to be in the office. Overall, personal experience with working from home is rarer than experience with employees that occasionally do so.

“I could work at home more often, but as a supervisor, you have to be approachable” (M023, male manager Bank NL).

“Other people work from home probably more frequently than I do, because as a head of the department people need to see me. I feel I need to be in the office” (M115, female manager FincomUK).

Most managers in our study appear to have experience only with workers who work from home occasionally or only part of the day. Very few managers have subordinates working from home for one or more days a week on a regular basis. If they do have experience with working from home on a regular basis it is usually restricted to one or only few persons in the department. Most of the managers interviewed favor flexible and occasional working from home practices above a more structural telework arrangement. This is also true for managers working in companies with a formal telework policy. In fact, having a telework policy in the department not necessarily coincides with a more positive telework attitude among all managers. Even when the company formally supports teleworking with a policy, there is a variation in attitudes towards working from home. In fact, managers working at a workplace that lacks a formal policy can express a very positive attitude, whereas some managers working in an organization with a formal policy express very negative views. Some of the managers are even willing to do anything to prevent their subordinates from working from home. In response to the question what their attitude would be towards an employee's telework request, one manager answered:

“I will do my utmost to stop it” (M002, male manager Fincom.NL, very negative attitude).

Managers mention several reasons why their subordinates work from home (occasionally). The most common reason is to finish a report without being disturbed or to work on a project assignment without interruption. Another reason is the avoidance of commuting time, the latter is particularly important for people working far away from home or when the business firm is located in a central area that is difficult to reach because of traffic problems. Often work-related reasons are mentioned (deadlines, undisturbed, productivity), although particularly Swedish and British managers also mention home-related reasons, such as keeping an eye on the plumber, or a sick child. In the Swedish

governmental organization this is supported by explicit policy that defines telework as an instrument that can support working parents.

An important factor in the occurrence of telework practices in the department appears to be the technological support and infrastructure and security issues. In many cases, telework practices are restricted when people cannot (safely) access the server from home or need files or information that is only accessible at work.

Generally speaking, the type of work subordinates do is an important factor in managers' telework attitudes. Usually, reading and writing allows working from home, whereas work that requires sharing equipment, team work, or face-to-face contact with clients does not. Managers first look at the type of work that needs to be done. As one manager says:

“It is a task driven thing, it is what people are working on”. (M117, female manager, Fincom.UK)

3.2 Arguments

Although (technological) ‘teleworkability’ often is a necessary condition for teleworking, it not always is a sufficient condition. In the interviews, also other arguments were put forward that underpin managers' attitudes towards teleworking in their departments. Some arguments are mentioned more often than others, some arguments are presented in combination with other arguments, and in some cases, managers explicitly weigh different arguments.

Control and coordination arguments

Control issues are one of the dominate arguments in the interviewed managers' narratives. Managers fear a loss of control and, as a result, opportunistic behavior of their employees as they will be more sidetracked when working at home. Therefore, many managers put forward the importance of output management and control as an additional contextual condition for telework. Some find telework difficult, though not impossible. In fact, both managers who are positive and those who express a negative attitude towards telework are concerned with control problems, in particular in the absence of output performance measures.

“If someone works at home, you can not measure what he has done or not.”
(M028, male manager Bank.NL, positive attitude)

The manager quoted above advocates individual output management which the company currently does not allow, in order to protect employees' privacy. In some cases, the control problem is also present in the ‘normal’ situation, so the additional control problem is not that large. Despite this, attitudes towards structural telework in the department vary:

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“I think I can handle it [telework PP et al.] very well, but I have to see what they are doing. But that is also a problem in the office, to see what each individual worker produces. We are no coca-cola factory.” (M033, male manager Bank.NL, positive attitude)

“People produce well. Of course, you can not see what they have performed, but that you can also not see when they work here (at the office). People are rewarded on the basis of their output and whether they do not overstep their budgets.” (M029, male manager Bank.NL, negative attitude)

Especially employees who have more responsibilities and autonomy in their work are allowed to work from home already:

“[Telework is PP et al.] Very common on an ad hoc basis. And almost done without people needing to ask. We expect the most professionals to be able to manage their time”. (M112, female manager Fincom.UK, positive attitude)

In line with this, managers accept (occasional) telework when employees need to finish a report, or to do some substantial reading. This type of activities can (better) be done in isolation and output is visible and can be easily checked (the delivery of the report).

Managers also often put forward arguments that refer to coordination and communication aspects of work. They stress the importance of face-to-face contact with clients and with and among coworkers, especially when work is done in teams. In case the work requires less communication, managers think telework is more feasible (M004). Face-to-face contact is also necessary for managers to be able to support, coordinate and plan activities (M210) and to motivate and convince, which is much harder to be done through e-mail (M029). In fact, frequent face-to-face contact is viewed as one of the critical success factors in work (M030). Distant working makes the work of the manager more difficult and disrupts the work of the team (M209). Also the absence of supervisors is viewed as a disruptive factor, and therefore, managers are not positive towards their teleworking.

“Assistant supervisors have access to telework according to our official telework policy, but I reject all their telework requests, as in order to supervise, you have to be present.” (M009, male manager Fincom.NL, positive attitude towards informal teleworking, but negative attitude towards formal telework).

Coordination and communication problems can be reduced through several IT-strategies. Some teleworkers call up their voicemail every few hours (M111). In some departments, mobile workers make use of a registration system that tells who is working where and how workers can be accessed (M013, M015). Next to the technological context, also the number of teleworkers in the department can play a role in managers' telework attitudes.

“It is fine when it [telework PP et al.] is just some doing it. If a lot more would make a request I think we would have to talk it through. It might create a problematic situation as it demands communication, cooperation and organization. But you have to discuss it from a coworkers point of view as well. After all, a dissatisfied person will not perform very well. It might also be an issue among the other coworkers if someone cuts down in time” (M204, female manager Service.SE, positive attitude).

Commitment arguments

In the quote presented above, the manager argues that too many teleworkers in the department would increase the odds of work processes being disrupted. At the same time, however, she acknowledges that there are commitment arguments that should be taken into account as well when judging an employee’s telework request. Also other managers consider telework as part of the exchange relationship. When shaping their attitudes towards a telework request, some combine organizational commitment and control arguments.

“As a manager you have to look to the work and outcome which might be more difficult when you do not have the people in your room. But the people who work in other cities have skills that the organization wants.” (M201, male, Service.SE, positive attitude towards occasional telework, negative towards fixed telework day)

Highly valued skills can be an important factor in the manager’s telework attitudes, even despite higher management costs associated with working at a distance, which is in line with the commitment/dependency theory. The “skill factor,” however, can also lead to the opposite attitude supporting the transaction costs/disruptiveness theory. Another manager in the same company says:

“We can not have two people with expert knowledge sitting at home at the same time which is another reason for being careful with these arrangements.” (M203 Service.SE- male, positive attitude towards telework).

Not all managers take the organizational commitment aspect into account. Some managers do not see the need for teleworking in their department. Some reason that employees are paid to be in the workplace, others even call working from home a ‘luxury’:

“It is pure luxury. If you have to work, you just come to the office” (M005, male manager Fincom.NL, negative attitude).

Strikingly, the organizational commitment (dependency) argument competes with arguments related to commitment and cohesion among co-workers and learning on the job. According to the manager, the teleworker does his job, but does not show any extra role behavior which the manager regrets and attributes to him teleworking. Hence, in the exchange relationship, managers do not only expect workers to do their own work as good as possible, but they also expect contextual performance, i.e., extra-role behavior, like helping co-workers and teaching them how to do the work.

“I don’t want someone working from home 5 days a week, because if you are building a team it makes it more difficult. Similar, with a guy who moved to the West country to live, it was a big question in my mind: do we want to accommodate him because he becomes very detached from the team. So you have to weigh up his contribution versus the principle of building a team.” (M113, male manager Fincom UK, basically positive attitude)

The argument of social cohesion is also mentioned by other managers as an important factor shaping their attitudes towards teleworking in their departments.

“Employees should stay in touch with the organization and their colleagues. So, there must be a good balance between sufficient contact and home-working.” (M022, male manager Service, NL).

“You have to be careful that employees will not become isolated from work, as it is also a social phenomenon.” (M017, female manager, Service.NL).

“I am not so in favor of teleworking. I think personal contact is very important. Face-to-face communication is crucial. A mail-culture exists already. That creates a distance.” (M026, male manager Bank.NL).

In line with the extra-role behavior argument, managers stress that employees need to be in the office because part of the education people receive on the job (M031, M003). This argument in particular applies to younger workers and relates to the work done and training received in consultancy firms. On the other hand, more senior workers need to be at the office to coach younger workers.

“My experiences with working from home are good. I do think you must make sure that you don’t do it too much. I believe that people do work hard at home but it is important to keep in touch with others because through that you get part of your training. This is in particular important for junior workers” (M012, male manager Fincom.NL)

“We learn an awful lot from each other by doing different things in different ways. (M119, male manager Fincom.UK).”

Trust arguments

Granting a telework request signals that the manager supports and trusts his/her subordinate (and trust, in turn, generates organizational commitment). Although all employment relations are based on trust to some extent, not all subordinates are trusted equally. The interviews reveal that good job performances (in the office) are a basis for generating trust that replaces concurrent control. In response to the question whether some of her employees work at home, one manager replied:

“Yes, but they should ask for permission first. Usually, I allow them to work at home, but some are not allowed when I do not trust it. In that case, I let them come to the office, so that I can see them. (M017, female manager Service.NL).”

“Telecommuting: that I allow for people who perform well. People who do not perform well, I forbid to work at home, since it is not visible what they do.” (M011, male manager FINCOM.NL, negative attitude towards fixed formal telework day).

Some managers are on the look-out for abuse of telework, and some are even pretty cynical about teleworking, especially when it is requested for non-work related reasons:

“In practice it is difficult, since it has to happen on a fixed day and you have to be aware that it is not a veiled parental leave.” (M009, Male manager Fincom.NL, negative attitude towards fixed telework day)

“... All those men who work at home, they do not do anything at home. They are surrounded by three crying children and they wives tells them to go shopping and they have no time for work.” (M005, male manager FINCOM.NL, negative attitude)

In many departments, teleworking happens more often at a senior level (M122). From the interview data, however, it is not clear whether senior workers are considered more trustworthy, whether they are rewarded for their (long term?) commitment to the organization, or whether learning on the job is of less importance to them. Possibly, the seniority argument covers all these factors.

“Every Friday she goes home and I think that is just a great example of somebody very senior embracing more flexible working policies” (M114, male manager Fincom.UK).

The final quote summarizes our findings up to now, by showing how managers weigh pros and cons of telework in their department, assessing all possible arguments (team

building, communication and coordination problems, disruptiveness of the manager's work, trust aspect).

“I would be a bit doubtful [toward teleworking: authors] and pay attention to the reason: it depends a lot on why you want to do it. After all, the fellowship within the work team would disappear and it would be more difficult to stay informed about what is going on. There are positive parts, but I am still a bit conservative and prefer people to be at work. It makes it easier for me as a manager to communicate with my co-workers. As I am doing that I am not negative towards it, but it can't just be a free choice. If one is doing it, everyone might want it. That is also why the reason for it is important, than I can decide depending on a special situation and not to allow it in general.... It is based on trust....” (M 209, men Service.SE, positive attitude)

3.3 Testing the hypotheses

Table 3 present the outcomes of the vignette study. Model 1 only takes those variables into account that relate to the transaction cost theory and disruptiveness theory, both emphasizing the governance dimension of the employment relationship. In line with expectations, managers supervising higher educated personnel are more favorable towards their subordinates' telework request. However, in contrast to expectations, also employees with highly valued skills that are difficult to replace receive more favorable attitudes of their managers. The organization having a formal telework policy or the employee having a supervisory position or not do not affect managers' attitudes towards the request. In addition to these findings, we find that managers in public organizations have more positive attitudes towards telework requests than managers in the private sector. Other control variables entered in the model were not significant.

Model 2 looks into factors affecting managers' attitudes towards concrete telework request from a dependency theory approach and commitment approach, emphasizing the exchange relationship between organizations/managers and their employees. Again, we find managers to have a more positive attitude towards an employee's telework request when the job requires a higher educational level. Moreover, managers are better disposed towards the request when the employee doing the request has highly valued skills. Both findings are in line with the expectations derived from the dependency/commitment theory. The tightness of the labor market, however, does not play a significant role in managers' attitudes.

Table 3 Results of multilevel analyses to explain managers' attitudes towards hypothetical requests of employees to work at home occasionally for a day (n=195 requests, 65 managers)

	Mo del 1	Mo del 2	Mo del 3	Mo del 4
Constant _0	4.6 8***	4. 66***	5.91** *	5.2 9***
Variables at the managerial level				
Organization has no formal telework policy	<i>Reference category</i>			
Organization has a formal telework policy	0.35	-	-	0.18
Consultancy firm / bank / insurance company	<i>Reference category</i>			
Government organization	1.26*	1.30'	0.93	1.12*
Work in department requires low/middle education	<i>Reference category</i>			
Work in department requires higher education	1.27*	1.44'	-	1.58**
Manager is a man	<i>Reference category</i>			
Manager is a woman	-0.46	-0.46	-0.24	-0.06
Sex manager is <i>not</i> similar to sex employee	<i>Reference category</i>			
Sex manager is similar to sex employee	-	-	-0.40	-0.90
Education level manager is <i>not</i> similar to education level employee	<i>Reference category</i>			
Education level manager is similar to education level employee	-	-	-0.08	-0.94
Variables at the request level				
Employee is a man	<i>Reference category</i>			
Employee is a woman	0.11	0.12	0.09	0.07
Employee has no supervisory position	<i>Reference category</i>			
Employee has a supervisory position	-0.04	-	-	-0.03
Employee has no specialized knowledge/skills	<i>Reference category</i>			
Employee has specialized knowledge/skills	0.31*	0.31'	-	0.35*
Labor market is relaxed at time of request	<i>Reference category</i>			
Labor market is tight at time of request	-	0.13	-	0.08
Variance components				
Level of the manager	2.85***	2.88'	3.37***	2.86***
Level of the request	0.82***	0.82'	0.80***	0.76***

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; hypotheses tested two-tailed

Model 3 looks into factors relating to similarities in social characteristics between the manager and the employee doing the request as social similarities were expected to generate trust that is essential in telework practices. In this study, similarity was made operational by looking into gender and educational similarities. However, both these factors were not shown to affect managers' attitudes towards employees' telework requests.

Model 4 looks into all factors that were entered in the previous models representing all three dimensions of the employment relationship: governance, exchange and co-operation. Again, it was found that managers had more positive attitudes towards requests of

employees' having jobs that required higher educational levels and of employees who had highly valued skills and who, therefore, are more difficult to replace. These findings support the dependency/commitment theory. However, also the transaction cost/disruptiveness theory suggests that managers will be more favorable towards request of higher educated workers as they are often just to more job autonomy and time-spatial flexibility already. Moreover, this type of workers is often managed or can be managed and rewarded on the basis of output.

Conclusion and discussion

The experience with teleworking among the financial service managers that participated in this study is in most cases restricted to working from home occasionally a day or part of the day. Most of the managers favor this flexible and incidental working from home practice above a more structural telework arrangement. Using working from home on a flexible basis means that it works two ways: employees can occasionally work from home during work hours, but also in the evening or the weekend. In general, managers want to safeguard flexibility and have a say in whether and when their subordinates work from home or are present at the office.

Managers vary in their attitudes towards teleworking, ranging from very positive towards extremely negative. Generally speaking, managers are not necessarily against teleworking, but prefer to stick to more conservative management styles, and are therefore selective in granting a telework request. When judging the telework request, they weigh costs and benefits associated with distance working. The interview data reveal that the different arguments that were analytically distinguished are often intertwined, which makes it sometimes difficult to discuss them in isolation. However, control arguments and the coordination problems associated with it are at the forefront. Both managers with a positive and a negative attitude are concerned about these issues and stress the importance of output management and control and face-to-face contact. Managers worry about the productivity of working from home and whether family obligations distract people from work. Private reasons are, therefore, less likely to convince managers to allow telework than work-related reasons, although in Sweden private reasons seem to be more accepted and the point of view of the subordinates are more often taken into account. Our findings suggest that managers define the employer-employee relationship primarily in terms of governance tasks.

Some managers, however, do take the valuable skills or contributions of individual workers into account when considering the telework issue and are aware of the risk of losing organizational commitment when a telework request would not be granted. Especially employees contributing well to the performance of the organization are allowed teleworking, for that very reason. Only when the contribution of the employee suffices he/she is allowed to work at home. This issue of the exchange relation is also closely linked to the trust argument put forward by the managers. Seniority might be one of the factors that generate trust.

More important than managers' worries about organizational commitment, however, appeared to be their concerns about the effect of teleworking on the social cohesion within the department, and the helping behavior among their subordinates, including mutual learning. These worries indicate that managers do consider commitment among employees as an important factor in the exchange relationship. This argument, however, also relates to the dimension of the employment relation that emphasizes the co-operation and social aspects of work. This was overlooked in the theoretical framework.

The vignette study affirms that managers are more likely to allow higher educated workers access [20]. Combining this finding with the interview data, it can be concluded that especially the job autonomy (control and coordination argument) argument can be used to explain this finding, but it is also likely that the fear of violating the psychological contract (commitment argument) plays a role (under the condition that they perform well). This latter argument is also shown by the importance of the highly valued skills employees have that plays a significant role in accommodating a concrete telework request. Again, this points out to the fact that working from home is not a benefit that is open to anyone, but can be viewed as an 'idiosyncratic deal' [21] that has to be negotiated with the manager and is based on trust.

Considering the trend towards social sustainability in organizations, we can conclude that the more conservative attitude of managers, viewing home-based telework as a benefit for only some of the workers, prevents telework to become a strategic tool for companies that can improve organizational effectiveness and employee commitment for all on a long-term basis. It maintains the situation that telework practices result from bottom-up initiatives, and are used as *ad hoc* based temporary solutions. Especially teleworking men combining work and family life was not met with enthusiasm by the managers, which does not stimulate a more equal distribution of paid and unpaid work within households. The interview data, however, also hinted at the importance of the contextual situation in the organization. Although formal telecommuting arrangements were no guarantee for positive attitude towards teleworking, output management and information technology were factors that were of importance for managers to support working from home. We should keep in mind, therefore, that although managers can exercise some degree of choice in the fundamental approaches to the way their subordinates are managed, their chosen management style is constrained and influenced by environmental factors and the actions and reactions of the other parties to the employment relation (Edwards, 2003). Some managers with a positive attitude towards telework in their department felt restricted by the way work was organized and rewarded. Therefore, in order to study the shift towards social sustainability from the managers' point of view, we should look further and study managers' attitudes and telework decisions in the context in which managers operate. This may include the influence of top-management, HRM-managers, co-workers and customers.

Finally, both the interview data and the vignette study provided no support for the importance of social similarity (gender and educational level) as a factor in managers' telework attitudes. May be, the number of vignettes in this study did not suffice to analyze this subtle mechanism.

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Alternative Strategies to Manage Non-Independent Workers at a Distance

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Abstract: This chapter describes previous research, presents relevant theories, and gathers some empirical data on the problem of management of virtual work for employees which do not have the necessary skills generally required for independent working. We applied the four variables identified and described in Bergum (2005) that might improve the person-job fit: leadership, competence development, changing the job contents, and improved organizational support like better information systems or local leader-resources. By personal interviews with 3 telemanagers in Norwegian Public Road Administration, we found that all variables mentioned above were relevant. Informal competence development happened, and leadership was more complicated on distance, especially related to communication. But our small number of interviews also indicated that situational leadership is not as easy as in the theory, because of limited resources for the leader (for example time) and also because Norwegian and Nordic working culture favour limited or no differentiation. Our three examples also illustrate the possibilities for leaders to make informal and more hidden “discriminations in favour of the non-independent” teleworkers. All three leaders complain about the problems that non-independent workers take more of their time, and this has negative effects for other workers. Organisational development and organisational support have been applied to a minor extent so far, but these will be more relevant in the future.

Keywords: telework, management, situational leadership, distance, employee-competence

1. Introduction and Research Problem

Norwegian Public Road Administration (NPRA) has during the last four years had a special focus on virtual work arrangements (also called distributed work or telework). This is due to the fact that regional administrations of NPRA have been decentralized, but local work units have been maintained at their previous location. Another factor has been the establishment of specialized resource units located together with the regional administrations. Both these factors will increase the amount of work over geographical distance. Experiences from these arrangements have previously been documented by reports from the Norwegian Work Research Institute (Bjørnholt, 2002; Bjørnholdt and Heen, 2004), Selvik, 2004, Bergum & Selvik, 2004, and Bergum, 2005). These reports

focus mainly on experiences for employees of these work arrangements, especially how employees perceive the effects of having their leaders on geographical distance, with a focus on trust, motivation, communication and control.

Virtual work in NPRA represents in many ways a pioneering project: The first aspect is that managers/leaders are also working virtually. The second aspect is because of the large amount of virtual work. Of 12.000 employees in total, between 20-25% are affected by these new work arrangements. This means more than 2.000 workers that have their boss at other locations, which is a much higher number than is common in most of the telework studies presented both scientifically and commercially during the last two decades. One of the main problems that have emerged for leaders is how to handle people that are used to have their leader near-by ready to answer questions when they arrive. The leaders in NPRA told us during a meeting in February 2005 that one of the disadvantages of the new organisational form was that they were regularly interrupted by these “non-independent workers”, who had to call or send SMS’ several times every day. To describe this problem and find solutions for how managers should handle this problem, is the research topic for this chapter. Because the goals for this work arrangement in NPRA are different than in most other telework projects, all people in a department are potential virtual workers. But when you have this selection criterion, you got the problem that not all workers fulfil the “traditional requirements” of being independent and working based on goals and not detailed instructions. Because telework research has been focused on selecting the right jobs and people for telework, this research questions has been hardly addressed. But this question will be more relevant in the future where a growing number of people will have leaders, colleagues and business partner at other geographic locations because of restructuring through functional specialization, centralizations, outsourcing, globalizations, all factors made possible by the development within ICT.

The purpose of this chapter is to apply relevant theories on the problem of virtual work for employees which do not have the necessary skills generally required for independent working, on NPRA. First we present the literature on the selection of and the required personality profiles for teleworkers, together with a general situational theory of leadership and a model of person-job (P-J) fit. Second we present empirical data from NPRA, where we will try to find out which strategies or activities should be taken by the managers. These variables are: leadership, competence development, job contents and organisational support.

2. Previous research, selecting teleworkers

The problem on how to manage and develop non-independent workers is central to working life research in general, but not in virtual work/telework. The problem of non-independence has however been a major topic in part of the research on call centers. Their problem is the opposite of ours: workers in call centers require more independence to develop their competence. In this chapter we will present some research findings of the skills of managers and workers in virtual work environments. A focus will be on the required skills

of teleworkers, the selection and what is called the person-job fit". At last a general leadership theory will be described, situated theory according to the competence of the employees.

2.1 The responsibility of managers in virtual work

Management in virtual environments has been relatively well-covered in popular telework-literature during the last decade, with many normative articles and books written on effective "telemanagement". The literature is summarized in the work of Bergum (2000). This literature claims that managers must support and be involved in making formal plans/policies for telework in their companies. An important part of a plan, and therefore also a part of a telemanager's job, is the selection of the "right" teleworkers and the selection of appropriate telework-jobs or tasks. Telemanagement further requires management by objectives (MbO) and focus on results, and not on the observation of processes. Managers must do more planning, and telework requires more formal operational plans for the dissemination of information, reports, meetings and availability. Managers must select workers based on the requirements of being a teleworker: Several different words are used, but the meaning is the same. Teleworkers must be more *empowered and self-managed*, and *trust* between manager and teleworkers is critical in cases of remote management. A "rule" in management at a distance is that only existing employees should have the opportunity to participate in telework. A basis for trust between manager and remote workers is good communication between them. "*Effective communication*" is thus another key word in distanced management. This also includes increased managerial requirements of managerial know-how in how to utilize electronic communication technology. According to Lamond (2000) an individual supervising a tele/virtual work arrangement should ideally have better than average supervisory and communication skills and should be able to clearly define specific tasks and expectations. While true for all jobs, it is especially important for supervisors of employees who are teleworking to review work performance against pre-established objectives. One message from the results is that there is no "one best way" to manage teleworkers (Lamond, 2000). We need to recognize the importance of adopting an approach, as individual managers and as management collectively, which is consistent with the company's goals and cultures. We therefore see that organisational culture is as situational factor for leadership in telework. Lamond (2000) also segments telework according to the following variables:

- whether the role is home-based at a remote office, or mobile
- whether the telework has high or low knowledge intensity
- whether intra-organisational contact is high or low
- whether external contact is high or low.

Lamond (2000) also says that much of what is good management of workers in traditional settings is also good management in virtual settings, and vice versa.

2.2 The skills of teleworkers, and the selection problems

Successful virtual work does require a specific combination of skills and motivations. Some writers in the telework area argue that these are specific skills, but others claim that these are capabilities required of all or most workers in today's workplaces. The number and names of these skills vary from author to author, but the skills mentioned below cover the most central arguments mentioned in the literature. However, a lot of the literature is either telecommuting or virtual team-based, so this will bias the arguments a bit. Typically, skills and traits for effective telecommuting include:

Successful teleworkers tend to be independent, and do not need constant supervision or feedback

- They don't have a high need for continual social interaction or for be with "the gang" at the office
- They tend to be proven performers in their jobs
- They are apt to be self-motivated, well-organized and disciplined in their approach to work
- They share mutual trust with their managers
- They have a good understanding of their own job requirements
- They have strong communication skills (written & verbal)
- They have technical ability and computer proficiency (hardware, software, peripherals)

Also arguments like time management skills and supportive family/home environment are mentioned in some studies. The last one is especially relevant for home-based telework.

While many US studies claim that teleworkers should be strictly selected based on the characteristics of workers personality, together with the characteristics of jobs, there is more discussion on this in the Nordic countries. This is a reflection of more democratisation in working life, with the emphasis on equal rights/opportunities. There is a debate for example in Norway on the question of how many people should have the opportunity to telework. Some people think that telework should be only for the few selected. Others argue that most of the employees should at least have an opportunity to try out telework. One element in the debate has also been if newly appointed workers should have this opportunity. Most of the respondents in the studies by Bakke et al (2001) think people argued that newcomers should be familiar with their boss, their colleagues and the culture of the organization before they started to telework. An opposite argument was that telework was used in recruiting of new people, and that new people should be independent and work independently of distance.

Experiences from organizations applying telework have shown us that teleworkers are very independent subordinates that more or less always work independent, both at the traditional work place or at a remote location. In some of the organizations that had field trials with telework in Norway, one of the requirements for teleworkers are that they must be independent. Several of the leaders expressed their view that they wanted teleworking subordinates that did not require frequent contact with their closest leader. (Several teleworkers say that there is no difference in how leaders evaluate and monitor even if they are teleworkers). But there are variations in the opinions of teleworkers of how they accept

the in-frequent contacts with their remote leaders. Some leaders emphasize that participants were driven by themselves, and that there is no need for “surveillance”, while others to a larger extent put telework on the agenda and were concerned about the contact with the teleworkers. Bakke et al (2001) further say that you should be careful to apply typologies of personality to express/say firmly who is suitable for telework. In telework it is important that the leaders know their subordinates, and together with their employees make/develop strategies for how to implement telework according to the goals of the organization. According to Bakke et al, the requirements in the literature are very “idealized”: *“Related to such general requirements for telework each organisation must also consider which work tasks have the potential for telework, and what part of the work that could take place on distance”*.

Lamond (2000) has written one of the few real academic articles on the topic of personality and telework. His conclusion is that telework will not suit all workers equally. The question is more to find a right match between the person and the job rather than finding the “right” person for the teleworking job. Lamond thinks that teleworkers need to be conscientious, like all other workers, but need to a greater extent to be self-reliant and self-motivated. They also need to be disposed towards the different co-worker and supervisory relationships and different communication patterns that off-site work requires. Lamond therefore also says that the question of which psychological type is best suited to telework does not have a straightforward answer, and it depends on which form of telework we are considering. He defines telework as varying along five dimensions: location, ICT usage, knowledge intensity, intra-organizational contact, and extra-organizational contact. This is compared with different psychological types measured by variables on: extraversion, introversion, sensing, intuition, thinking, feeling, judging and perceiving.

2.3 “Person-environment fit”

An interesting and relevant model in accordance with the arguments above, is proposed in the article by Shin (2004), called a person-environment fit model for virtual organisations. According to Shin (2004) previous studies on telework or virtual organisations have largely focused on the effects of specific types of virtual work arrangements like telework or telecommuting on employee morale and productivity rather than the individual characteristics necessary for employees to be effective in virtual environments. Further, findings of these studies have often been contradictory. These inconsistencies imply that virtual work arrangement may not be appropriate for everyone, and that certain individuals are likely to be better suited to work in a virtual setting than others (Cascio, 1999). A person-environment (P-E) fit framework can according to Shin (2004) help us to understand how employees can fit into virtual organisations, and how a good fit affects individual outcomes. The term “P-E fit” refers to congruence between the attributes of an individual and those of environment (Schneider, Smith & Goldstein, 1992). The underlying assumption is that individuals will be more effective when the attributes of person and of situational environment match or are at least highly congruent (Ostroff, 1993). Virtual employees will be more satisfied and perform better when there is congruence between their attributes and those of a virtual environment. Shin (2004) examines P-E fit at different

organizational levels, person-, person-group, and person-job. The last one is the most relevant for us. This refers to a match between individual characteristics and job requirements (Edwards, 1991) and has been generally operationalised as the congruence between employees' knowledge, skills, and abilities (KSA's) and job demand. Shin (2004) proposes domain knowledge, computer literacy, the ability to work autonomously, and time management skills are proposed as the most important KSA's for achieving person-job fit (P-J) in virtual organisations. In order to identify the KSA's required to achieve P-Jfit in virtual organisations, the characteristics of a virtual job must be examined. Shin (2004) said that virtual jobs generally are: knowledge-based and performed by employees who possess specialized knowledge or expertise. Because virtual employees operate remotely from one another, without any fixed time frames, they are also heavily dependent on the use of electronically-based information technologies (e.g. email, intranet, videoconferencing). If virtual employees are going to perform their jobs efficiently, they need to be computer-literate.

As stated earlier, relationships in virtual organisations are often asynchronous and geographically dispersed, which makes it difficult for virtual managers to monitor and oversee their subordinates. Hence, employees are expected to complete their work with minimal supervision and feedback. Virtual jobs require more autonomy with respect to work schedules, methods, and pace than traditional jobs. In order to be suited to virtual jobs, virtual employees should be able to work autonomously. The ability to work autonomously encompasses attributes such as being self-motivated, self-directed, and self-disciplined. Specific examples of the ability to working autonomously include being motivated to focus on work, completing tasks on time with minimal supervision and feedback, being comfortable at working alone, and adjusting to the relative isolation of working at an alternative worksite (Mariani, 2000). These requirements are in accordance with the skill-requirements referred earlier. Training and socialization are mechanisms that can help incumbent employees in virtual organisations achieve greater P-J fit, according to Shin (2004). Although values and personality are stable and difficult to train, knowledge and skills can be more easily acquired through training and education. Training of technological proficiency and effective collaboration skills can aid virtual employees in working as a team effectively (Joinson, 2002). Socialization is another fundamental tool for achieving fit in organizations, according to Shin (2004). New-combers adapt themselves to their workgroup and job by learning the organizational culture, workgroup norms, and task roles and demands from their supervisors or co-workers.

2.4 What about virtual work and low-skilled workers?

During the 1970s and 1980s, most of the research on telework/telecommuting made forecasts: These stated often that the potential for this type of work was among women with routine type of work (like data entry, word processing etc), located in rural areas. Over the years, the experiences from telework research indicate that the diffusion has taken place mostly among mean located in commuting distance from larger cities, having knowledge-intensive positions, and working remotely 1-2 days a week as the most common

arrangement. Typically mobile telework, virtual organisations and virtual teams are now the most popular types of virtual work. And this means complex tasks. Kirkman et al (2004) say that virtual teams are often used to address complex tasks of significant importance. Cascio (1999) and DeSanctis et al (1999) say that since work arrangement of virtual teams and virtual organizations have emerged to meet the needs of knowledge-based competition, virtual jobs are often knowledge-based. Sparrow & Daniels (1999) say that employees in virtual teams possess specialized knowledge or expertise. Therefore, virtual employees are expected to have knowledge in specific domain areas in order to fit their jobs (Grenier & Metes, 1995). Most of the studies on virtual work during the last decade have been on knowledge intensive work, if we do not include call centre work as virtual work.

Among some researchers call-centre work is defined as one type of virtual work or telework, because there is a distance between these workers and their customers, and often their principals. But because call-center workers are sitting together with an own boss in the same building, some researcher do not include them in the statistics. Undoubtedly call-centres include mostly low skilled work, even if there are different types of call-centre work, from simple outgoing transactions to more demanding ICT-support jobs. Call-centres or customer relation jobs do therefore include low skill jobs, but on the other hand are these jobs so structured/routine, that there are few problems to satisfy the job requirements even with limited education and work experience. The problem is rather the opposite of what is reported in the person-job fit in NPRA, because the problem is rather that the many call-centre employees have more competence than required in these types of jobs. Without discussing the topic of whether call-centre work is virtual work or telework, there are few experiences to bring into the problem of how to make better fit between job requirements and personal characteristics for the non-independent virtual workers in NPRA. We therefore have limited reported experiences from the literature. The message is that to have effective telework, you need skilled and independent and self-motivated virtual workers. If this is not the case, the virtual work arrangement will not be successful and the employees (and manager) will be disappointed or frustrated.

+ Supportive Behaviour	SUPPORTING (S3)	COACHING (S2)
	DELEGATING (S4)	DIRECTING (S1)
	-	+
	Directive Behaviour	

Table 1: A theory of situational leadership

Previous studies on the management of telework or virtual work therefore have presumed that the employees should be independent. If they are not, the work arrangement will not be successful. If they do not have these knowledge or skills, they have to train. We therefore need to find a general leadership theory that can guide us in how to manage the non-independent workers. One alternative for this is to look at the theories of situational leadership. The assumption of situational leadership theories is that the best action of the leader depends on a range of situational factors. In simple terms, a situational leader is one who can adopt different leadership styles depending on the situation. Hersey and Blanchard created a model for Situational Leadership in the late 1960s (Hersey & Blanchard, 1969) that allows us to analyze the needs of the situation you are dealing with, and then adopt the most appropriate leadership style. It has been popular with managers over the years because it is simple to understand. But does it work? Factors that affect situational decisions include motivation and capability of followers.

Blanchard and Hersey characterised leadership style in terms of the amount of direction and of support that the leader gives to his subordinates or followers, and they created a simple matrix or grid:

- Directing Leaders define the roles and tasks of the “follower”, and supervise them closely. Decisions are made by the leader and announces, so communication is largely one-way.
- Coaching Leaders still define roles and tasks, but seeks ideas and suggestions from the follower. Decisions remain mainly by the leader, but communication is much more two way.
- Supporting Leaders pass day-to-day decision, such at task allocation and processes, to the follower. The leader facilitates and takes part in decisions, but control is with the follower.
- Delegating Leaders are still involved in decisions and problem-solving, but control is with the follower. The follower decides when and how the leader will be involved.

According to the theory, effective leaders are versatile in being able to move around the grid according to the situation, so there is no one right style. The right leadership style will also depend much on the person being led, called the follower. They extended their model to include the Development Level of the follower. They said that the style of the leaders should be driven by the Competence and Commitment of the follower, and came up with four levels:

Human Resource Management Practices

4	High Competence High Commitment	Experienced at the job, and comfortable with their own ability to do it well. May even be more skilled than the leader.
3	High Competence Variable Commitment	Experienced and capable, but may lack the confidence to go it alone, or the motivation to do it well / quickly
2	Some Competence Low Commitment	May have some relevant skills, but won't be able to do the job without help. The task or the situation may be new to them.
1	Low Competence Low Commitment	Generally lacking the specific skills required for the job in hand, and lacks any confidence and / or motivation to tackle it.

Table 2: Leadership style according to the competence and commitment of employees

Hersey & Blanchard said that the Leadership Style (S1 - S4) of the leader must correspond to the Development level (D1 - D4) of the follower - and it's the leader who adapts. By adopting the right style to suit the follower's development level, work gets done, relationships are built up, and most importantly, the follower's development level will rise to D4, to everyone's benefit. This theory both pretends to both describe the variety in the leadership behaviour, and this matrix is also used as a foundation to develop both leaders and subordinates from the simple and most “undeveloped” situation towards a situation where subordinates have more freedom and competence (Strand, 2001). According to this theory, depending on the skills and independence of the employees, there are right and wrong solutions to choose between. An instructive and “job-oriented” way for the most non-independent workers, a selling and participating form for the medium motivated, and a delegating form for the most independent workers. For the non-independent workers in NPRA, the solution according to this theory is to have leadership based on directive behaviour and detailed instructions.

There have been several studies to test the hypothesis of Hersey & Blanchard. According to Grønhaug et al (2001), most studies fail to find a correspondence between the relevant variables. One exception is the support for a directive style of leadership when followers are low on competence and commitment. This is therefore relevant for our research question. One of the problems with this model according to Grønhaug et al (2001) is that leaders are poor in describing their own behaviour. They propose that the evaluations of leaders should be done either by the subordinates or external observers. However, Grønhaug et al (2001) and other writers think that the situational theory adds something to the leadership debate, because there is a need for flexibility in leadership style because of all internal and external changes in organizations.

3. Earlier studies of virtual work in Norwegian Public Road Administration

3.1 Background and description: organizational development with virtual work as a consequence

The empirical base for our study will be Norwegian Public Roads Administration (NPRA), with a special focus on the Eastern Region. This region consists of the Norwegian counties Oppland, Hedmark, Oslo, Akershus and Östfold. The administrative headquarter for this region is located in Lillehammer, in Oppland county, 180 km north of Oslo. This region is organized with seven local offices, responsible for operational activities. As a support for the regional management team, some staff positions have been established. There is also a regional resource unit that, independently of geography, has been created to provide competence and extra capacity to the other units in the region. The philosophy behind this is to increase effectiveness in utilizing professional know-how and resources, and take advantage of larger collocated teams that can provide better opportunities for knowledge-development. This organizational form was established on the 1st of January 2003. Generally this re-organization has resulted in a small geographical movement of people, and most people work with the same type of jobs as before. Some employees sit together with familiar people from the old organization, but they are now organized in new structures with a new leader, and some new colleagues, partly located at other geographical places than themselves. A main difference is that a larger number of people will have their leader at a distance, at least for part of the week.

3.2 NPRA compared to previous studies and other theories

Type of virtual work

Virtual work in NPRA is almost not home based work, which has been researched a lot during the last couple of decades. People in NPRA works at an office. The basic model of work is what researchers in the 80s and 90s called satellite offices; you work physically at the local office even if you conduct tasks for other geographical parts of the same organisation. But it is more relevant to say that the work arrangements in NPRA are a mix of mobile telework and virtual teams.

Degree of virtuality

NPRA could be regarded as a virtual, according to the definition by Shin (2004). A virtual organization is often defined as one that frequently engages in external ties, possesses an internal structure of virtual teams that band and disband according to specific goals or needs, and consists of employees who are located remotely from one another. Four dimensions can characterize virtual organisations: space, time, culture and boundary (Shin, 2004). The degree of virtuality depends on the extent to which an takes on more of these four characteristics (Kraut et al, 1999). What we can say about NPRA is that this is mainly internally focused, even if part of the al has been outsourced. The cultural dimension is

therefore relatively easy and non-virtual. The organisation consists undoubtedly of employees who are geographically distributed. And they use a lot of asynchronous communication media. So the space and time dimension is highly relevant. Because NPRA has a relatively homogenous culture and has been rather internally focused, the degree of virtuality is not that high on these indicators. In total this means that the degree of virtuality is at a modest level, according to the definition by Kraut. We can also notice other characteristics of virtual work, for example the requirements of being competence based, which is partly true in NPRA. This is discussed in the next sub-chapter.

Competence of the virtual workers

NPRA consists mostly of engineers, middle aged men, of whom a considerable numbers have a university degree. The majority of the workers are therefore within the target groups for virtual work, satisfying the requirements for such work arrangements. The focus of our chapter is however on the minority of people, who have been ignored in most of the research on virtual work and telework, the non-independent virtual workers. Because of the size and originality of virtual work in NPRA, the problem of non-independence happens. And we saw in the previous studies done by Shin (2004) and Martins et al (2004) that they characterize virtual work as being competence-based. This is only partly true for our case. The general trend has been that the most successful telework jobs have been competence jobs, but then we do not include call centre work as telework. As said before there has been research on the managerial problems in call centres, but these are the opposite of what we have in this chapter. Jobs are too boring compared to the competence of the call centre workers, so there is a poor P-J fit also here.

The problems for managers of virtual workers are availability and support for practical work problems...

In the studies presented earlier the reported problems and challenges for the virtual workers have been not to get access to their distant leaders and this has been related to the need for support for rather routine practical tasks. These problems are different than reported in many other studies of virtual leadership, focusing on motivations and communications, that means more social support. This had to do with the characteristics of NPRA as a virtual organisation, the unique goal for virtual work (especially the size of the project) and the low competence of the virtual workers. The theory of situational leadership says that subordinates with limited skills should have leaders with a more directive style of leadership. This means that managers of non-independent teleworkers generally should be more controlled and monitored than recommended in the traditional literature on management of telework and virtual work. We will find out more about this in our empirical study among leaders.

What is the appropriate level and structure of communication?

Previous studies on telework require that teleworkers should be independent in order to have an effective and successful work arrangement. Implicitly the authors say that with a gap or misfit between the work requirements and the qualifications of the teleworkers, virtual work will fail, and both the manager and the employees will be dissatisfied. We have seen in the studies done in Norway that the non-independent workers have been frustrated mainly because they do not have the necessary access to the leaders, and their work is postponed. On the other hand we have heard from the leaders that they are frustrated because of too many interruptions from the remote workers. These are the observed effect reported in the studies and our talks with the leaders in NPRA. Often there seems to be disagreements about the necessary level of interaction, even if regular communication is generally seen as important. Our immediate reaction to this is that there seems to be a need for more planning between the leader and the employee, to agree on how and how often you should communicate, but also how to deal with matters that needs urgent actions. How to handle the irregular cases seems to be a challenge in NPRA, even if you plan in advance? One prerequisite for dealing with this is of course that the remote employee has the decision power for these operational or/and tactical problems. Another prerequisite is better competence for the teleworker, to be able to cope with these day-to-day questions. Training was also mentioned in the article of by Shin (2004), as one of the few specific advices on how to improve the P-J fit. We will later in this chapter propose some general recommendations on various alternatives for improving the P-J fit in management of non-independent teleworkers or virtual workers. In our planned empirical study among virtual leaders, the question of appropriate level and structure of communication will be included. One aspect not discussed so much here, but which is important, is the use of electronic communication media (ICT). NPRA has all types of equipment, but is not using telephones and videoconferencing a lot. More asynchronous media like email and Intranet is used a lot. What are the reasons behind this: Is the communication need a result of competence, culture or the communication need? This will be explored in our future study among virtual leaders.

3.3 Theoretical solutions to improve the P-J fit in NPRA

Firstly we assume that the solution of firing the employee or closing the virtual work option is not relevant. Then, theoretically it is relatively easy to describe the various alternatives to improve the P-J fit in NPRA on a general level, even if we need more specific knowledge on some variables, for example of skill requirements and the motivations of the remote employees in question. We apply the argument of “easy”, even this is a relatively rare problem in virtual work. This is because this general problem is common with similar challenges of competence development and organisational change that many organisations face today. Another question is how to deal with these questions more practically, but this is beyond this chapter.

Basically we can change four main variables to improve the P-J fit:

- **the leadership**, for example more directive leadership and more support
- **improve the competence** of the remote employee, including basically the necessary skills and motivations. In this way the remote employee will be able to work more independently.
- **change the contents of the job**: the employee could keep the routine parts of his job, while the most complicated tasks are removed from the job description. Alternatively these could be taken together with the leader either on the telephone or at face to face meetings.
- **additional organisational support**: this variable includes several alternative activities to improve the support for the employee, beyond the support from the leader. Example at a rather specific level could be: using ICT-tools like Intranet to give answers to support the employee and other potential user. Another example is to have additional support persons collocated with the employee. This solution does often happen in virtual organisation, where you have a local leader to take care of the HRM-subjects.

4. The empirical study

We have made an empirical study in NPRA to find out more about these variables mentioned in the previous chapter 3.3. We have interviewed three managers who have most or part of their subordinates at other locations than their own. Two of the managers were interviewed together (manager two and three), but we present the answers separately.

4.1 The topics in the interviews

These questions below were the basis for our interviews. We will however only present the answers that were relevant for the respondents and the answers relevant for us to answer the questions about managerial activities for the non-independent teleworkers. During the interviews we had to adjust to the respondents, so the interviews were more open than what we thought should be rather “structured versions of semi-structured interviews”.

- a. What percentage of your personnel working as teleworkers do not have the necessary skills to have such work arrangement?
- b. How big is this problem, besides the number?
- c. How do you find out that some teleworkers are non-independent?
- d. How are the non-independent teleworkers influenced by telework, are they getting more insecure?
- e. Leadership: what type of leadership is appropriate for non-independent teleworkers, do they need to be more controlled?

- f. Competence development: what types of competence development are used for the teleworkers to adjust to this work arrangement?
- g. Changes in job content: have there been any changes in the jobs for the non-independent workers after the reorganisation, and eventually what kind of?
- h. Organisational support: what other support activities have been arranged by the company to improve the adjustment between the wishes of the teleworkers and the job requirements, as ICT-support, local support person?
- i. Communication and availability: challenges of finding adequate communication frequency and volume, and the requirements for availability
- j. Other solutions: can telework be non-relevant for certain types of people?
- k. Other comments

4.2 Interview with the first "telemanager"

This manager is in charge of 33 subordinates in his department. 2 of these people could be regarded as non-independent teleworkers. He thinks that the required competence for a teleworker should be:

- be safe on his own profession
- structured, have routines and systems for work
- communication: write, write emails, use the telephone, express problems, dear to ask for professional help,
- organising his daily work
- do not have personal problems (marriage, fear etc)

Low productivity produces negative waves, non-independence and dissatisfaction. They are dissatisfied because they are not that effective, and this has lasted for some years. The insecurity increases because of fewer contacts and use of more lean media. Of other more general comments he stresses the importance of mutual trust and honesty.

Because only 2 out of 32 do not telework effectively, the problem of non-independent teleworkers is not that significant in his departments. These two "dependent" people do not have a central position in his department. He also thinks that this is dependent on the type of industry. In a more competitive industry you cannot have people who do not work properly, and there it is more legitimacy to make changes with the personnel. This is not the case in NPRA. But lower productivity gives negative waves, and non-independence often means dissatisfaction, because they do not work effectively. He also thinks that insecurity happens because of less contacts with the leader and use of more lean communication media.

He notices that teleworkers are non-independent because they produce less, are dissatisfied, they make problems where other people take him for granted, or they are quiet and do nothing. But he admits that the distance also can cause difficulties to sense personal/psychological problems, and especially the day to day problems.

Leadership: Regarding leadership, he strongly advises "close/tight leadership" for teleworkers, that means that F2F-communication and personal meetings are necessary, at regular intervals. Other challenges are to solve practical problems, availability, and

communication. But he is clear to say that it is difficult to have different styles of leadership towards different types of people. Norway is an egalitarian country, and rumours will arise. He also thinks that some leaders are good distance leaders, when they are good communicators, and when they are good listeners. He also thinks that non-independent workers require more leadership than ordinary workers. They should have been more controlled and more support, but he does not have the necessary resources (for example time), and he also repeats that it is not easy to differentiate between workers.

Competence development: This depends on the potential of the teleworkers. Nothing is done in this case. They have been followed up professionally, and he has quality cheques more often, dependent on the motivation of the teleworker. The person who tries he has more trust than the one who does not try, and behaves more poorly.

Changes in job contents: He thinks that personality is more important than the job. He also says that there are fewer routine jobs than before. One possibility is to transfer persons to other jobs which have a collocated leader. This is done other places in NPRA, but not in his section. The respondent emphasizes that he in principle is against a split between the professional and the personnel parts of leadership.

Organisational support: They have not done anything special because of the minor importance of the problem. In other departments they have professional coordinators who coordinate activities across different departments who have the same geographical location.

Communication: the non-independent teleworkers are more insecure and frustrated. But it is difficult to differentiate, and in some ways it works. Planning is important, but it is even more important to follow-up after the planning. Several leaders and subordinates think there are challenges to deal with several locations and persons, with many unknown variables at the same time. This creates increased complexities which requires more competence to master different cultures, changes etc.

Telework for all? Can telework be irrelevant for certain types of people: The respondent says clearly yes.

4.3 Interview with the second "telemanager"

Description of job: he is the leader for roads and geodata, and has 27 subordinates. His main location is Hamar. Subordinates are located in Lillehammer, Hamar, Oslo and Moss, with 5-8 people at each place. He is in Hamar 3 days a week, Lillehammer once a week, and in Oslo depending on the need. He is too rarely in Moss.

The number of non-independent teleworkers: Among 25% of the teleworkers do not have higher education, and many of these do not have the necessary knowledge. But he also adds that this is also a question of personality. The significance of the problem is therefore different from the numbers. But the significance of this problem could be interpreted in the other direction because one non-independent teleworker can give negative effects for other colleagues and for external contacts. Counting non-independent teleworkers, he said that 5-6 people could be included in this category.

How do you find out that some teleworkers are non-independent? They do the wrong priorities, and they do not deliver. But it is not always easy to notice.

How are the non-independent teleworkers influenced by telework, are they getting more insecure? Dissatisfaction increases, and they complain because of too little contact. I should have liked to have more contacts with them, but this also has negative effects for the other workers. The non-independent workers require more of me.

Leadership: what type of leadership is appropriate for non-independent teleworkers, do they need to be more controlled? Operational leadership is difficult over geographical distance. The non-independent workers complain because of too little communication. But it is difficult to be "everywhere at the same time". This is different from top managers who have always been travelling, but they do only scratch the surface and only have symbolic tasks when they travel and make visits. Travelling is a big challenge for telemanagers, and it raised physical challenges as you have to take care of your health. Often I have to work at night or during the weekend, because of all travelling. So it is difficult or impossible to be at every location every week, as have been shown to give positive results in NPRA (ref Bergum & Selvik, 2005).

Competence development: what types of competence development are used for the teleworkers to adjust to this work arrangement? I try to stimulate them to be more independent. I make demand saying: you have to do this yourself. I have to specify my requirements more concretely, and I split up the goals into more specific operational goals. For these reasons I have to accept more errors especially in the beginning, as I accept that the non-independent teleworker will at least try.

Changes in job content: have there been any changes in the jobs for the non-independent workers after the reorganisation, and eventually what kind of?

Change in job content is a continuous process. I have taken away some competence intensive tasks for some people especially when younger more educated people have been hired. This can produce frustration because they feel ignored. Then enough and right communication is very crucial, in order to have their legitimacy. But you should not be too specific about the reasons.

I think we have tried to combine combination of competence development, change in job content and organisational support, when people in Oslo has moved from one place to another. The reason for the teleworker was to be part of a larger milieu, and where a support-person was present. This produces competence development, perhaps some changes in job content, and some organisational support. This is possible in Oslo because of a small geographical distance.

Organisational support: what other support activities have been arranged by the company to improve the adjustment between the wishes of the teleworkers and the job requirements, as ICT-support, local support person?

ICT is used a lot including videoconferencing and netmeeting. These are used especially for information dissemination. Regarding a local support person, we have been considering this, but we have not done this yet. But other departments in NPRA have used this, but not in this region. Another solution could be to transfer person over to other functions which have a collocated leader. I also refer to what I said earlier.

Communication and availability: challenges of finding adequate communication frequency and volume, and the requirements for availability. I am available most of the time, and they expect me to be available, even if I am located at other places. Or perhaps it

is more important in this situation. I require from the teleworkers to be active. In the case of unanswered phone calls, I do not call again. So there is a need for communication competence.

Other solutions: can telework be non-relevant for certain types of people?

Telework is mandatory in NPRA, so that means that this question is of no relevance for us. We have to do our best, depending on the specific situation. But I consider changing the jobs of some few people, away from telework, because they are frustrated, like everyone else.

4.4 Interview with the third "telemanager"

Description of job: He is the leader for the traffic section, and is located in Lillehammer. He has 34 subordinates, and these are located in Lillehammer (7 people), Hamar (6), Oslo (11), Kjeller (4), Billingstad (1), Moss (4), Sarpsborg (1). I am on travel 70% of my working time.

The number of non-independent teleworkers: Half of my workers have no academic education, but the problem is not that big. I think we talk about 2-3 people. Some tasks are OK, because they are structured, workers have a long experience, and they know people at other places from before.

How do you find out that some teleworkers are non-independent? It is not always easy to follow processes at other places. I have one person who is very dominant and it is hard for me to see how he behaves on a daily basis, because he can hurt others. He is no diplomat. A female teleworker is often depressed because of corrections from this "informal leader/colleague". And it is not easy for this strong man to take my signals from distance. So operational leadership at a distance is a challenge.

How are the non-independent teleworkers influenced by telework, are they getting more insecure? Dissatisfaction is larger, and they complain because of too little contact. I should have liked to have more contact, and the non-independent requires this, but he has negative effects on my relationships to others. The non-independent could be more insecure, because there are language problems, cultural problems at a distance. And it is not so easy for the subordinate to "cry on the shoulder of the leader", when at a distance.

Leadership: what type of leadership is appropriate for non-independent teleworkers, do they need to be more controlled? He mentions that communication is crucial for management at a distance. He agrees with the second respondent that operational leadership is difficult at a distance.

Competence development: what types of competence development are used for the teleworkers to adjust to this work arrangement? I try to make them more independent. I also make demands, that they should be more independent.

Changes in job content: One person is not delivering up to my expectations. I have plans to relocate him to another location, where there are more people. Then he can be part of a larger milieu, be motivated and learn more.

Organisational support: what other support activities have been arranged by the company to improve the adjustment between the wishes of the teleworkers and the job requirements, as ICT-support, local support person? I have no specific activities on this

point, so far. But we have an informal leader in Hamar, who was a formal leader before. I think he has an informal position now, that helps my teleworkers in Hamar. I know they have collocated leaders in the Western part of NPRA, but we have no specific plans for this.

Communication and availability: challenges of finding adequate communication frequency and volume, and the requirements for availability. I am available most of the time. They can call me around the clock. And 3 people make calls regularly. But apart from this: it is almost too quiet. I can also say that some of my subordinates have low competence in writing, so the telephone is important for these people.

When I am in Oslo, there are a number of meetings. These give me dilemmas. Some people also take a lot of time when we met. But it might have negative effects for others. It is difficult to say “stop”, when they see me so rarely. To see people face to face regularly makes distance communication more easy. But generally I have a challenge to find out what is the necessary level of communication: What is good enough? And communication face to face is necessary, but this means a high number of trips. So I am tired of all this travelling, in addition to supplementary work during the weekends.

5. Short analysis

We have presented three managers, who all have subordinates at a distance. All three managers have some non-independent teleworkers. But the problem is of minor importance for two of these managers. All three managers think that this management over distance is more complex than ordinary management. Especially all travelling, operational management and communication about personal issues are complex and challenging, both physically and mentally.

What about the application of our four variables to reduce the gap between competence and work requirements?

Leadership: what type of leadership is appropriate for non-independent teleworkers, do they need to be more controlled?

Competence development: what types of competence development are used for the teleworkers to adjust to this work arrangement?

Changes in job content: have there been any changes in the jobs for the non-independent workers after the reorganisation, and eventually what kind of?

Organisational support: what other support activities have been arranged by the company to improve the adjustment between the wishes of the teleworkers and the job requirements, as ICT-support, local support person?

We have seen that all these four variables have been relevant, but not all of them are relevant for one single manager. Competence seems to be the most applied variable, because telework itself and their managers put pressure on them to be more independent. We have also seen that our three teleworkers try to put pressure on the non-independent teleworkers to try to solve the problems themselves, or to specify goals more clearly. Regarding leadership, we see that these people require more time and support and guidance. But especially the first telemanager underlines that it is not possible to because of

time/resources and egalitarian culture to practice a very situational type of leadership, depending on the competence level of teleworkers.

Regarding changes in job content, these examples have shown some very few examples, but there are some further plans because some non-independent workers are frustrated and do not deliver up to goals and expectations.

Organisational support: our three respondents have not reorganized to have local leaders in addition to the present organisational structure. But there are a couple of informal leaders, with both positive (former leader in Hamar) and negative effects (“strong man”)

Conclusions

This chapter describes previous research, present relevant theories, and gathers some empirical data on the problem of management of virtual work for employees which do not have the necessary skills generally required for independent working. We applied the four variables identified and described in Bergum (2005) that might improve the person-job fit: leadership, competence development, changing the job contents, and improved organizational support like better information systems or local leader-resources. In our empirical study among 3 virtual leaders in NPRA, we found out that all variables were relevant. Informal competence development happened, and leadership was more complicated especially related to communication. But our small number of interviews also indicated that situational leadership is not as easy as in the theory, because of limited resources for the leader (for example time) and also because Norwegian and Nordic working culture favour no differentiation. But our three examples also illustrate the possibilities for leaders to make informal and more hidden “discriminations in favour of the non-independent” teleworkers. But all three leaders complain about the problems that non-independent workers take more time, and this has negative effects for other workers. Organisational development and organisational support have been applied to a minor extent so far, but these will be more relevant in the future.

Even if the number of non-independent teleworkers was not enormous, and the number of operational jobs will be reduced, we need to know more about telemanagement of operational activities with people without an university degree.

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Diversity, Conflict, and Trust: Computer-Mediated versus Face-to-Face Teams

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Abstract: The network literature largely suggests that the choice between computer-mediated and face-to-face teams should be based on the presence or absence of trust. Computer-mediated teams are appropriate when there exists trust; face-to-face ones when there is distrust. This chapter disputes this reasoning by focusing on the case where (dis)trust is the result of diversity amongst the team members. The presence or absence of functional and/or sociocultural diversity leads to four situations, which can be typified by the kind of conflict that is bound to occur: no conflict, task conflict, relational conflict, and process conflict. When distrust is due to high sociocultural, but low functional diversity (relational conflict) we suggest computer-mediated teams are the more appropriate form.

Keywords: Face-to-face teams, Computer-mediated teams, diversity, trust, conflict

Introduction

Owing to the increased interconnectedness of today's world, businesses are confronted by an increasingly diverse and globally dispersed workforce, and by global security threats, forcing them to optimize their interaction processes. Computer-mediated meetings allow firms to interact with various stakeholders dispersed over large geographic distances without exposing members to terrorist threats targeted at business travelers. 9-11 in particular has triggered much consideration of this alternative to face-to-face meetings. Obviously, computer-mediated meetings differ substantially from face-to-face ones and can thus not replace the latter automatically.

The literature on electronic networks [e.g. 1]) has particularly focused on the presence of trust as a determinant for the appropriateness of a certain meeting format, i.e. face-to-face or computer-mediated. It largely suggests that computer-mediated interaction between team members is particularly appropriate for situations where there already exists trust amongst the members [2], by implication face-to-face interaction is considered more

appropriate for situations of distrust. This is in line with much of the conflict literature, which recommends such face-to-face interaction for overcoming distrust [i.e. 3].

The literature on diversity has analyzed the interaction amongst team members from diverse backgrounds. While diversity is often heralded as beneficial to team performance, a recent study by Von Glinow, Shapiro, and Brett [4] found that in multicultural teams members can experience high levels of emotional conflict. With respect to the format of team meetings they found that face-to-face meetings can actually be harmful, leading to increased rather than reduced levels of distrust in such multicultural teams. This is in direct contradiction with the electronics network literature that recommends face-to face meetings for situations of distrust.

This chapter proposes a framework that integrates the literatures on electronic networks and diversity and sheds light on the appropriateness of interaction formats for different settings. It starts off by discussing the merits of face-to-face versus computer-mediated teams, followed by a discussion of trust, which is considered essential for virtual teams. Then we discuss diversity, concentrating on the two dimensions of our framework: functional and sociocultural diversity. Next we discuss and put forward propositions for the four situations that these two dimensions depict, which can be typified as situations of no conflict, task conflict, relational conflict, and process conflict. We conclude with implications for those studying virtual and face-to-face teams and provide recommendations for future study.

1. Trust & Face-to-Face versus Computer-Mediated Interaction

There exist many definitions of trust, but many of these are captured by the definition proposed by Rousseau, Sitkin, Burt and Camerer [5: 395] with trust defined as “a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another.” Such a psychological state can exist for various reasons, but an important one in the context of this chapter is relational trust. Relational trust comes from frequent interactions and is based on knowledge about the relationship with the trustee, i.e. it is identity-based [6]. Because relationships take time to develop, relational trust is not instantly granted but earned over time. Swift trust is almost the opposite of relational trust in that it is instantly granted as part of professional conduct based on clear roles [7] ignoring the identity of those involved. However, it is very weak [8] with few teams ever showing any increase in levels of swift trust. While other forms of trust also exist, such as calculus- and deterrence-based trust [5] when discussing trust below, we are primarily referring to relational trust.

Relational or identity-based trust is much easier to achieve in face-to-face teams than in computer-mediated teams because the members of the former (1) are copresent in time and place, (2) can detect ‘social context cues’ [9] that go with human interaction, and (3) have instant feedback [1]. Because computer-mediated teams lack this copresence, direct human interaction, and instant feedback the rationale is [10] that they must already possess trust prior to their formation in order to function properly. Face-to-face interaction is considered to facilitate the development of such trust, and by inference it need not

necessarily be present before members meet. Hence, face-to-face meetings are often deemed necessary before any virtual meetings are to occur [11].

2. Diversity and Conflict

Globalization has resulted in an increase in team meetings where members from diverse backgrounds interact. Such diversity can relate to various aspects be it experience, training, age, gender, race, or culture. Two important dimensions of demographic diversity that relate to whether conflict builds or is resolved [12] are functional background diversity and emotional diversity. Functional background diversity concerns the diversity in complete functional backgrounds [13], an attribute that is highly job-related [12]. Emotional diversity concerns the diversity in sociocultural backgrounds, an attribute that is more relational than job-related [12]. In the remainder of the chapter this is referred to as sociocultural diversity.

Diversity in teams is often heralded as beneficial for firm performance [14, 15] example because different viewpoints lead to more informed decisions [16] Notwithstanding, recent studies, in particular on top management teams, actually show mixed results regarding their performance. Amason [17].argued that besides functional effects, such as creativity and innovation, they also display dysfunctional effects, such as emotional conflict. Such emotional conflict may be further exacerbated when fault lines [18] exist in the team, i.e. subgroups based on demographic characteristics [19]. A study on multicultural teams by [20] confirmed that such teams may actually see an increase in the level of emotional conflict. They questioned whether participants would build trust when meeting face-to-face, suggesting instead that they ought ‘not to talk.’

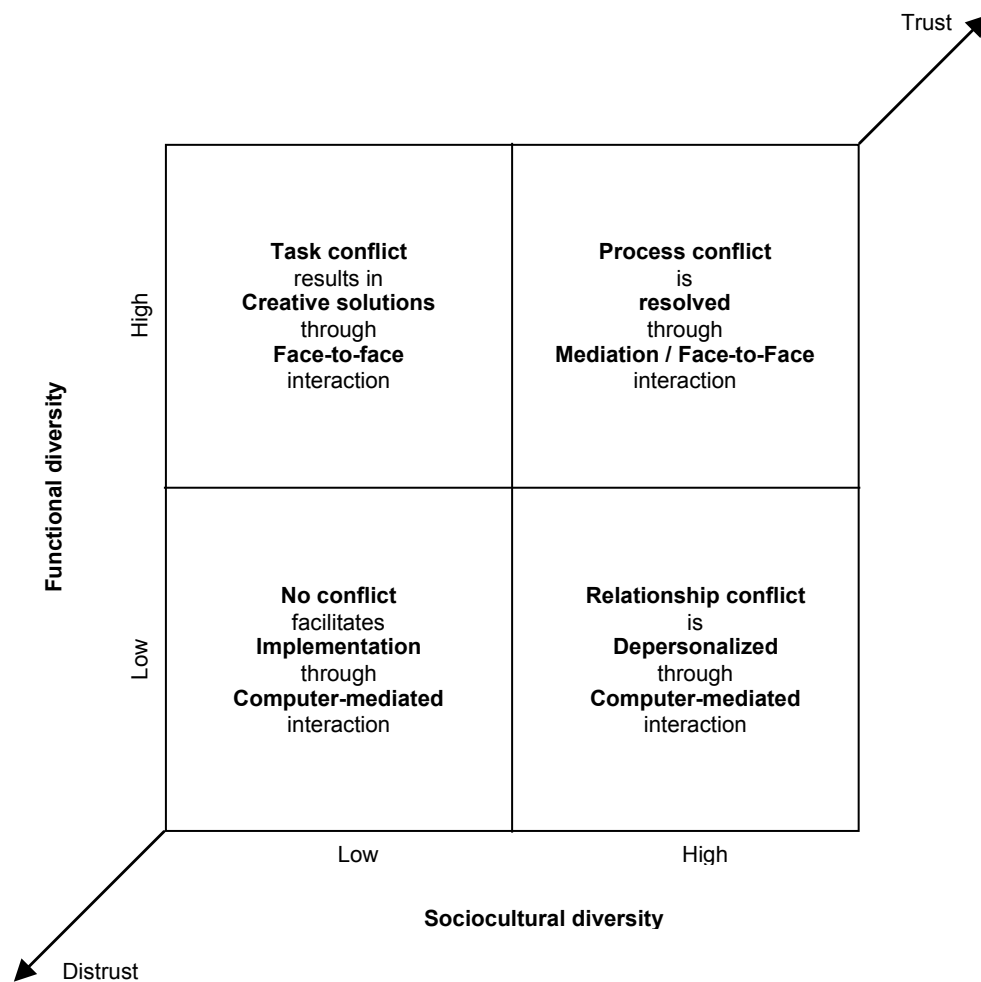
From the above it is clear that conflict plays an important intervening role on diversity and performance as stated by Pelled, Eisenhardt, and Xin [12]. The different types of conflict that result from the diverse composition of the team can be characterized in a framework using the two dimensions of functional and sociocultural diversity. We argue that each type of conflict is best suited for a particular team form, i.e. face-to-face and/or computer-mediated (see Table 1, next page).

2.1 No Conflict: (Implementation through Computer-Mediated Interaction)

In the absence of diversity, i.e. when there is strong similarity amongst team members, the belief systems of the members will be very similar, resulting in little conflict, which should facilitate the presence of trust. Because of the low functional diversity, i.e. there is a lack of different viewpoints, teams are well suited, not for dealing change, but for dealing with stable conditions. Computer-mediated teams are the appropriate mode for such situations of trust and stable conditions [21], because they possess efficient and effective implementation processes.

Proposition 1. When the functional and sociocultural diversity of a team is low, computer-mediated interaction is the most efficient and effective mode of interaction.

Table 1. Trust as diversity with four conflict modes



2.2 Task Conflict (Creative Solutions through Face-to-Face Interaction)

Functional diversity, in the absence of sociocultural diversity, primarily drives task conflict [12]. Such task conflict is considered positive because it is an indication of different perspectives coming together, i.e. knowledge is exchanged, a situation associated with creative insights. Functional diversity and the task conflict it drives are thus well suited for dealing with change. The copresence, human interaction, and instant feedback of face-to-face interaction makes it especially appropriate for situations of rapid change [21].

Proposition 2. When the functional diversity of a team is high and its sociocultural diversity low, face-to-face interaction is the most efficient and effective mode of interaction.

2.3 Relational Conflict (Depersonalized through Computer-Mediated interaction)

Sociocultural diversity, in the absence of functional diversity, is considered to cause emotional conflict [12]. Emotional conflict refers to relational conflicts between team members that arise because they belong to different sociocultural categories. Such emotional conflict is considered negative because it sours team relationships, interfering with the task at hand. The copresence, human interaction, and instant feedback of face-to-face interaction would only exacerbate any tension that exists between members. In such instances, it may be better not to interact directly [20], but instead to use computer-mediation. Such computer-mediated interaction depersonalizes the relationship, and instead puts the focus on the task.

Proposition 3. When the sociocultural diversity of a team is high and its functional diversity low, computer-mediated interaction is the most effective mode of interaction.

2.4 Process Conflict (Mediation or Face-to-Face)

When diversity is high, involving both sociocultural and task diversity, the process itself comes to a halt because there exists both task and relational conflict. The complete breakdown of the team, i.e. process conflict [22], can only be resolved if either the task or relational conflict is resolved. Only a face-to-face meeting or the help of an outside party, a mediator, can create a roadmap to move away from a situation of absolute distrust.

Proposition 4. When both the functional and sociocultural diversity of a team is high, mediation or face-to-face interaction is the most effective mode of interaction.

Conclusion

This study suggests that in instances of distrust, face-to-face meetings are not necessarily the preferred option for creating trust again, as the electronic network literature claims. When the distrust is the result of functional diversity of the team members, then indeed face-to-face meetings are preferred. But, when the distrust is the result of sociocultural diversity between team members, then computer-mediated interactions are the preferred option. If distrust is a mixture of both functional and sociocultural diversity then face-to-face meetings or mediation is necessary to get the process going again.

These contingencies hold important implications for practice and theory. From a theoretical perspective this chapter suggests that rather than talk about trust, as the network literature does, one should talk about underlying factors of trust such as diversity and conflict because they offer better insight into the benefits and limitations of the different modes of interaction. From a practical perspective, bringing members of a global team together for face-to-face meetings might actually create more distrust as opposed to trust because of perceived differences in sociocultural status. Most fundamentally, this study suggests that networks need not be based on trust at all, but can be used to create trust by providing a depersonalized setting.

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Project STRIDE

Developing and Implementing Strategies for Employing Teleworkers with Disabilities: Preliminary Findings from National Inquiry Data

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Abstract: STRIDE conducted a national inquiry of employers, examining general teleworkers with and without disabilities, and newly hired employees with disabilities. Benefits to employers are discussed, as well as challenges to both employers and teleworkers. Finally, plans for demonstrating recommended innovations are described.

Keywords: Telework, telecommuting, benefits, barriers, disabilities, employment

1. Project Background

1.1 Purpose and Rationale

Technology is changing today's workplace, providing ease of access to information and instantaneous world-wide communication. Using the Internet and email, employees can now seamlessly work away from the traditional work setting in the form of telework. For people with disabilities, telework sometimes provides the most viable opportunity to work.

Telework numbers are increasing, from four million teleworkers in 1991 to 28 million in 2001⁵. This growth holds true for the federal workforce⁶: there was a 93% increase in the number of federal employees who teleworked from 2001 through October 2003; while federal employees eligible for telework increased from 35% to 43% in 2002. More than 68% of the eligible federal workforce was offered the opportunity to telework mandated by Public Law 106-346 in 2002. And, a dramatic 86% increase was noted in the number of

⁵ International Telework Association and Council (ITAC)

⁶ OPM annual telework surveys

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federal employees teleworking because of medical or disabling conditions, to 1,749 in 2002 from 939 in 2001.

The potential benefits of telework for individuals with disabilities and for their employers has been heralded in the United States⁷ as well as in Europe⁸, yet the number of teleworkers with disabilities is thought to be relatively small⁹. However, the practice is gaining in popularity as federal and state agencies search for return-to-work strategies lower the cost of Workers' Compensation, which is estimated at more than \$2 billion and 2 million lost production days annually¹⁰.

Research has indicated a positive indication of employer receptivity to hiring teleworkers with disabilities. For example, a study by Dr. Jarrett (co-investigator for STRIDE) found that 47% of employers would consider telework for new employees with a disability. Another 19% would "possibly" hire a new teleworker with a disability. And, 62% of employers with telework employees said they would recommend hiring new employees with a disability and allow them to telework immediately¹¹.

However, there is a surprising lack of any national research on teleworkers with disabilities. In addition, many factors complicate our understanding of current research in the field:

Telework can have a wide variety of definitions. It takes place in varying locations, can vary in frequency, and there is a large variance of technology support and supervision needed for different telework jobs.

1. Little distinction exists between the conditions and job supports needed by teleworkers with disabilities as compared to teleworkers in general.
2. Limited scientific research has been conducted about both the job environments and strategies, contrast to barriers, that must be in place that encourage managers to hire new individuals with disabilities to telework.
3. Research has been conducted from either the employer or teleworker perspectives, not the combined factors needed to increase use of telework as an option for persons with disabilities.

Much remains unknown about telework and whether it will become a major opportunity for employment accommodations, or merely another workplace option utilized by a handful of employees. Project STRIDE is designed to implement new national research, validated on a regional and local level, to determine further how well telework will answer the needs of workers with disabilities.

⁷ Hesse, 1996; Jarrett & ILRU, 1996

⁸ Haddon, 1991; Murray & Kenny, 1990

⁹ Eaton, *High Tech Careers*, August 1998

¹⁰ Cost of federal workplace injuries when measured by workers' compensation losses

¹¹ *Questions and Answers about Telecommuting for Persons with Disabilities: A Guide for Employers*, The Institute for Rehabilitation and Research, Houston, Texas. April 1996.

3.1. Central Issues Investigated

Project STRIDE was designed to: 1) identify the circumstances and practices in which telework is most successful; and 2) identify the barriers that prevent more widespread use of telework for employees with disabilities. providing quantitative data for employment for persons with disabilities. The intent of the Project STRIDE's national inquiry was to:

- Gather information on general telework practices and identify pockets of telework in for-profit, public and non-profit organizations
- Identify types of jobs and industries for: 1) existing employees with disabilities who transition into telework; and 2) teleworkers with disabilities who are newly hired into telework functions
- Address employer success factors, barriers and job environments, which would promote the practices of hiring new employees with disabilities into telework

3.2. Methodology

Research was carried out in two phases, a pre-questionnaire followed by a full questionnaire, completed between May 21 and September 30, 2005

Pre-Questionnaire

This study distributed an 8-item pre-questionnaires concerning telework practices to 15,782 human resource professionals and managers from small and large businesses, federal, state, county and city governments, universities, hospitals and non-profit agencies.. Our research sample was not intended to be representative of all U.S. employers. It was used to qualify potential employer respondents for the full questionnaire. Respondent employers to the pre-questionnaire that either employed persons with disabilities or employed teleworkers were then asked to consider responding to the full questionnaire.

Of most interest were employers who had experience working with teleworkers, especially teleworkers with disabilities, as they would have more in-depth expertise on best practices for implementation.

Full Questionnaire

Of the 463 employers that qualified to proceed to the second phase of the study, 232 completed the "full" questionnaire (97% completed it electronically, with the remainder using a paper version). Of the 232 employers, 47.9% had employed teleworkers with disabilities.

2.4.1.1

Definitions

The following definitions were provided to our employer respondent populations.

Telework

To work at home or at a remote location during normal hours or shift, anywhere from one to five days per week, excluding occasional or after hours telework, sales forces and mobile workers.

Teleworker

An employee or contractor of a company/organization who works at home or at a remote location during “normal hours or shift”, anywhere from one to five days per week. This definition excludes the following: occasional or after-hours telework, sales forces and mobile workers.

Employee with a Disability

A person who has a permanent or chronic physical, mental health or sensory condition that poses a barrier to employment.

Teleworker with a Disability

1) An employee with a disability who has transitioned into telework from an existing in-house job; or 2) An individual with a disability who has been newly hired to perform telework, with no prior work experience with that organization.

3. Demographics

3.1 Employer Sector

In the pre-and full questionnaire, the majority of respondents were from the public sector. Approximately 60% were federal, state and local government agencies, although public sector employees comprise only about 15% of the total U.S. workforce¹².

¹² This difference is probably due to a combination of factors. First, it is necessary to differentiate between workforce (employees) and agencies. Government agencies on average tend to have more employees than for-profit sector firms. Second, the research staff's prior experience is that survey response rates from for-profit firms tend to be significantly lower than that from government agencies.

Employer Sector Representation		
Sectors		Response %
Response #		
Federal government	40	91
For-profit	20	44
State government	13	29
Non-profit	11	27
Local government	8	23
Universities	4	11
Other	4	10
TOTAL	100	235

Table 2

3.2 Industry

Federal, state, and local government agencies comprise 60% of the sample, but only 54% of these selected “government agency” as their employer industry. While some respondents could have chosen “government” as their employer sector, they instead selected more specific industry types such as education, communication, data processing/information technology, human services, and research within the government sector. On the other hand, other employer respondent selected both, leading to the greater than 100% response in Table 3 (next page).

Non-public industries were represented more equally, with five percent to seven percent for each of the following categories: technology, education, financial services, health care, and management consulting. The most telework opportunities, this response indicates that some telework tasks are dispersed among a variety of industries.

3.3 Workforce Size

The employee workforce sizes for all respondents, not necessarily those who have employees with disabilities that telework, were as follows:

Workforce Size	Percent
100-499 employees	26
20 or fewer employees	20
1,000-9,999 employees	19
10,000 or more employees	15
21-99 employees	12
500-999 employees	

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Percent of Telework Employer Respondents by Industry	
Industry	Percent of Respondents
Government agency	54
Technology	8
Education	8
Financial Services	7
Health Care	7
Management Consulting	6
Human Services	5
Communication	4
Research	4
Custodial, Janitorial and Business Management; Construction; Hospitality; Industrial; Retail Sales; Transportation	1 each
Child care; Service and Repairs; Data Processing and Information; Temporary Services; Leasing; Wholesale	0
Other	7
Total	118

Table 3

4. Summary of Findings Pre-Questionnaire

Project STRIDE received 521 pre-questionnaires. 79.3% of those responding indicated that they employed people with disabilities, and roughly half (46%) stating their company had ever had teleworking employees (regardless of disability.) 8% did not know if teleworkers had been employed.

Of the companies stating they had ever had teleworkers, slightly under one-half (107 or 45%) had both full-time and part-time teleworkers. Another one-third (78 or 33%) had only part-time teleworkers, while about one in eight companies (29 or 12%) had only full-time teleworkers. Of the remaining, fewer than 10% did not know the work schedule of the organization's teleworkers.

A slight variation of this question was also asked, requesting only the telework schedule of current teleworkers. Results from the 236 respondents were nearly identical to those of question three above with the main difference being a slightly higher average of full-time teleworkers (17%).

Finally, 48% of the companies that had ever had teleworkers indicated that some of the teleworkers were people with disabilities. (Yes – 48% (113 respondents) No – 17% (40) Do Not Know - 35% (83)) To the research team's knowledge, this pre-inquiry represents the largest set of responses about, and highest rates of participation reported for, telework by persons with disabilities.

5. Summary of Findings Pre-Questionnaire

Telework Practices in the General Workforce

- Large employers (greater than 500 employees) were more likely to implement telework for their general workforce as compared to employers with fewer than 500 employees.
- There was a higher proportion of general teleworkers in the non-government sector than in the government sector.

Employer Practices for Teleworkers with Disabilities

In terms of incidence for teleworkers with disabilities, there was no significant difference between government and non-government sectors. As our sample was composed of only employers that offered telework, statistical significance is not as relevant since we are not able to generalize to the US employer population. Instead we can describe what we found:

- 32% of government employers in our sample had teleworkers with disabilities compared to 24% of the non-government respondents.
- More for-profit and non-profit respondents had hired new employees with disabilities than respondents from the government sector.
- In comparing general telework incidence, employers with more than 500 employees had a higher prevalence of offering telework for employees with disabilities than employers with fewer than 500 employees. There was also proportionately more employers with greater than 500 employees who had current teleworkers with disabilities.
- There was not a significant difference in the incidence of teleworkers with disabilities among all sectors, government and non-government. There were more government employers (32%) with current employers with disabilities than for non-government employers (24%).
- Employers with 10,000 or more employees that currently offer telework are more likely to have teleworkers with disabilities that have transitioned into telework.

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Newly Hired Teleworkers with Disabilities

- There were no discernable trends for employer practices in hiring new teleworkers with disabilities; however, both for-profit and non-profit employers were more likely to provide opportunities for new teleworkers with disabilities.
- There were more opportunities for newly hired teleworkers with disabilities in employers with less than 500 employees. This contradicts the pattern we saw among general telework and disabled teleworkers, likely because of the small sample.

Job Tasks

- **The for-profit sector had the largest total number of general telework employees in data processing and information technology.**
- Across industries, office functions were the most prevalent telework job task.
- **The number of customer service telework tasks was reported higher in the private sector than in the government sector.**
- The tasks of research and analysis were listed highest in the number of job functions for current teleworkers with disabilities in the federal and state public sector categories. No local government respondents reported having current teleworkers with disabilities.

Employer Rationales

- Larger employers were more likely to be open to moving existing employees with disabilities into telework.
- Of all employers across all industries, ADA compliance was not reported as one of the top three reasons for starting telework in organizations. Although for organizations that had implemented telework, 59% listed compliance with the ADA compliance as a major benefit.

6. Observations and Discussion

6.1 Telework Incidence for Persons with Disabilities

Reports on telework incidence vary, depending upon the respondent population. The accuracy of all statistics, however, must be viewed cautiously as there are reasons why teleworking may be both underreported and over-reported. For example, in large companies of 1000 employees and more, it is difficult for telework activities to be easily identified through a single staff contact, especially if it occurs less than full-time. While telework could be widespread within the organization, our contact could lack adequate internal documentation to indicate exact telework jobs or tasks and frequency.

Another potential confounding factor was the language used for the different sets of employers. Incidence data were collected through the following questions, which varied in nature and in question language:

- For employers with teleworkers in general, the question was, “Have you ever employed persons who telework for some or all job tasks?”
- For employers with disabled teleworkers, the question was, “Do you have employees with disabilities who are currently teleworking?”

If we had asked respondents, both government and non-government, if they have EVER had employees with disabilities telework, rather than only collecting data on employers with disabled employees who are currently teleworking, perhaps there would have been a more meaningful difference between employing disabled teleworkers and teleworkers in general. Descriptively, it turned out that the government sector currently has more disabled teleworkers than the non-government sector does. We cannot say whether we would have found that the non-government sector ever had more disabled teleworkers than government if had the questions had been more similar.

The full inquiry uncovered that the most common type of telework was taking place in isolated situations (46%) which would seem to reflect that managers are responding to individual employee needs such as family issues, commute time, health, and assistance with job retention. Employers with greater than 1000 employees were more likely to offer telework to their general employee populations. Forty-five percent of respondents indicated that telework by persons with disabilities may typically occur throughout the company as individual employee need arises.

Almost 23% of employers responded that telework had assisted them to comply with the ADA, but this was not the most frequent response; nor did it provide the frequency of usage of telework as a disability accommodation. No employer listed ADA compliance as one of the top three reasons for implementing telework.

Since it would seem that the transition to telework would be easier for employees with disabilities who have proven work experience, we contrasted the incidence of existing employees with disabilities who moved to either part- or full-time telework with those *newly hired* teleworkers with disabilities who had no prior experience with the employer. As expected, the full questionnaire uncovered a much lower incidence of newly hired teleworkers with disabilities, with just 10% of all companies that offered telework. Employers are more open to making accommodations for existing employees possibly due to the fact that they have not had the opportunity to ascertain whether the new hire would be “worth” the investment of time and special arrangements a new teleworker with a disability would require.

6.2 Jobs and Industries Utilizing Telework

For teleworkers with disabilities, office functions, research and analysis, administrative tasks, technician, programming and customer service were most common. Across all industries, office functions for teleworkers with disabilities were most common. Job types performed by newly hired persons with disabilities, in order of greatest

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frequency, included research and analysis, office functions, call center, and administrative jobs. Except for research and analysis, these jobs were typically geared toward more entry-level skills.

Across industries, evidence suggests the teleworking jobs for persons with disabilities are quite prevalent in those industries with the most telework positions, such as finance, communications, data processing, and government. Government agencies also further reported similar industries. . It may be more efficient to segment government into more specific industry sectors to further identify additional opportunities.

6.3 Successful Practices

Our full inquiry addressed employer telework practices that apply to both organizations in general and those that specifically have employees with disabilities. Because 88% of employers had utilized telework for more than one year, and more than one-half used telework for five years or more, our employer population had substantial implementation experience. Based on their responses there appear to be several categories of conditions that facilitate teleworking by employees with disabilities.

1. Organizational conditions must support the overall use of telework. Telework opportunities for persons with disabilities may be related to broader and more pervasive management, technology, and organizational cultures that support teleworkers. . Telework may be utilized by only a handful of employees at start, but as the number of remote workers grows, employers indicated that company-wide supports had been recommended to encourage and manage telework. These supports included telework policies and/or agreements, flexible work policies, remote access guidelines, and training programs for teleworkers and their supervisors. All of these strategies were deemed important in both adopting telework and in shaping the employer's internal infrastructure and procedures to manage telework practices. They encourage organizational readiness and may strongly correlate with increased likelihood of expanding telework opportunities for employees with disabilities.
2. Address potential employer risks. Introduction of the telework concept may pose certain risks to an organization, if teleworkers have "employee" status, and governed by internal company policies for safety, liability, employee selection criteria, technology use, data security, and federal employment law. If supervisors lack the tools and guidelines to manage these remote workers, they increase the risks to both the employer and to the teleworker.
3. Address manager and supervisor resistance. The manager is critical to telework adoption. Some barriers include the manager's perceived ability to monitor performance as well as issues with fairness in employee selection.
4. Focus on employee skills and status. Employers were more likely to move existing employees with disabilities into telework, due to their familiarity with the employee's

performance and knowledge of the job. They were less likely to hire a new employee to telework as they know less about how an individual may work remotely, or details of their work experience. Future research needs to clearly define the hiring comparisons between newly hired teleworkers with disabilities and current employees with disabilities who transition into telework.

5. Fit of job to telework. Employers reported that only employees with certain types of jobs were allowed to telework because it was difficult to fit the appropriate job task to telework. Still, nearly a third of respondents felt that all challenges could be overcome. When asked about hiring a new teleworker with a disability, the majority of respondents indicated that this depended upon the fit of job tasks to telework.

6. Fully explain job carving/job restructuring. Generally, respondents were unaware of the possibilities of “job carving” or “job restructuring” as telework options.. This rehabilitative job approach relies on arraying tasks by work function complexity, “carving out” low level functions from higher level functions, taking away more routine tasks from existing employees. It typically combines enough tasks to allow for a realistic entry level position that might be performed by telework, and enables skilled and trained employees to focus more attention on high skill functions.

7. Pay attention to overall job market conditions. The availability of jobs was an underlying theme in many of the responses to the open-ended questions. This factor is often overlooked in analyses of teleworking for persons with disabilities. When employers are actively seeking a larger workforce, they will frequently consider different and more innovative arrangements such as teleworking to expand the labor pool. When fewer employees are needed, employers are less likely to seek new workers or permit arrangements such as telework. In terms of micro-level conditions, job placement counselors would be well served by focusing on expanding industries as well as categories of employers with disproportionate number of disabled teleworkers currently.

6.4 Employer Benefits

The majority of employers (73%) indicated telework helps them respond to specific employee needs. Employee retention and increased productivity rated second and third, with other respondents identifying cost savings and reduced operations costs. These rationales are not necessarily exclusive of each other. For example, as employers respond to specific employee needs by providing telework options, they may also be striving to retain that employee. The underlying fact is that telework, in most circumstances, enables increased employee flexibility and more effective job performance, which directly and often indirectly, leads to enhanced organizational productivity.

6.5 Barriers

Employers identified a host of problems and challenges in hiring employees with disabilities into telework jobs. It is apparent that many of the most frequently cited barriers concerned trust and monitoring of a new teleworker's performance. The lack of physical proximity to the supervisor is the underlying condition under which teleworker skill levels and work habits are "unknown". Note, however, that nearly one third (31%) of all respondents are optimistic that all challenges can be overcome.

Only 26 total employers had hired new employees with disabilities into telework, which points to the difficulties in finding these pockets of employers. To probe further, we examined 102 open-ended responses to a question, asking employers why they had not hired new employees with disabilities as teleworkers¹³. We expected certain responses, such as job is not a good fit, or management is wary of telework. Yet many responses indicate that telework by new employees with disabilities is far from a hopeless cause. Of the open-ended responses, 15 respondents said there was no particular reason for the lack of teleworking by new employees with disabilities. Six respondents said no persons with disabilities had applied. Another 11 respondents indicated the situation had never arisen. And 14 other respondents said they did not know why teleworking by new employees with disabilities had not occurred. Therefore, nearly half of the respondents (46 of 102) provided information which would not rule out teleworking for new employees with disabilities.

Responses to another question, "Would you encourage other divisions or groups within your company or organization to consider telework for new employees who have a disability?" also are promising. Of the 226 responding employers, only eight said "no" and another 23 said "don't know." Sixty-six said "possibly" and 129 said "yes" which represented 57% of all respondents. If one combines those responding "yes" with those responding "possibly," fully 86% of the respondents had a positive inclination.

7. Next Steps

The next phase of Project STRIDE's research will focus on in-depth examples of employers' use of telework with individuals with disabilities. It is expected that these case studies will provide insight into possible strategies and specific approaches for improving telework among disabilities, especially with regard to new hires. Main steps for the next year include:

- 1) Identify and describe the key elements of telework, including types and numbers of jobs, job and employee characteristics, and the work environments that are necessary for telework to be an effective strategy for returning persons with disabilities into the workforce.
- 2) Articulate these elements in the context of effective and innovative strategies through demonstration sites in Minnesota and Wisconsin by assisting 40 veteran and/or Workers' Compensation candidates to become employed in part- or full-time telework jobs in federal, state, and/or for-profit and non-profit sectors.

¹³ Q. 14. "Any particular reason why not?"

To accomplish these steps, we will:

- Hire Telework Coordinators in Minnesota and Wisconsin to oversee placement and development of Telework Business Advisory Councils, composed of specific businesses interested or practicing telework.
- Provide assessment, training, placement and follow-up as needed for each candidate.
- Place up to 40 teleworkers with disabilities who are veterans or receive Workers' Compensation over a 2-year period, and conduct rigorous evaluation through inquiries of teleworkers, their supervisors and co-workers.
- Conduct case studies of employers from national inquiry, along with local ones in order to interview teleworkers with disabilities, their supervisors, and project staff.
- Research outcomes will identify employer conditions and strategies, as well as pre- and post-teleworker job supports and skills, necessary for individuals with disabilities to obtain and sustain telework employment. The project will provide proven strategies for the successful hire, training, implementation and support for employing teleworkers with disabilities.

This document was developed by the Midwest Institute for Telecommuting Education and the Hubert H. Humphrey Institute of Public Affairs, funded by a grant agreement from the U.S. Department of Labor, Office of Disability Employment Policy (Number 17.720). The opinions expressed herein do not necessarily reflect the position or policy of the U.S. Department of Labor. Nor does mention of trade names, commercial products, or organizations imply the endorsement by the U.S. Department of Labor.

Preliminary Report

Telework/Telecommuting: Employers' Perspectives and Perspectives of Service Members and Veterans with Disabilities

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Work in progress. Please do not cite or attribute without consulting author. This study was conducted by Mathew Greenwald & Associates, Inc., on behalf of the WorkPlace, Inc. The study was part of a Telework/Telecommuting Pilot Research Project funded by resources provided by the Department of Labor.

Introduction and Methodology

This report presents the results of a telephone questionnaire of private businesses and public sector organizations in the U.S. regarding their views on telework. The study is part of an effort to explore telework as an employment option for service members or veterans who have disabilities. The objectives of the study were:

- –to determine how receptive businesses are to telework as an employment option
- –to identify the critical barriers to telework
- –to identify possible ways to encourage business managers to consider telework as an option for employees

The questionnaire was designed to provide unique primary source data of national significance focusing on the majority of public and private businesses across the U.S. that do not presently offer telework as an employment option, and as such, excluded employers that do currently offer telework. This approach was chosen because it allowed the questionnaire to delve into the perceived critical barriers to businesses offering telework

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and possible incentives available to encourage them to consider telework as an employment option.

Although the findings of this study will be used for expanding employment opportunities for disabled service members and veterans, the questionnaire asked about teleworking generally rather than for this specific group of individuals. This was to avoid the possibility that social desirability effects would lead to overstating employers' receptivity to telework. The questionnaire asked employers about the percentage of employees that have any kind of disability, but did not inquire specifically about the percentage of veterans with disabilities, because this target population represents a very small percentage of the total workforce

Information for this study was gathered through 9-minute interviews with a total of 1,002 respondents in U.S. businesses that do not currently allow telework and that have at least 5 employees. To identify these respondents, screening interviews were conducted with 1,221 businesses whose Dun and Bradstreet records indicate they have at least 5 employees. Of those, 2.8% reported their business does have a formal policy that guides employees and supervisors in implementing telework. Their interviews were ended, and only those who had no such policy or who had a policy not to permit telework continued through the questionnaire.

Respondents were people who make decisions on human resources policies and benefits. In order to ensure that the sample was representative, quotas were established for size of the business. In addition, to be able to examine attitudes within the public sector, a total of 100 interviews were conducted within that sector. The results were weighted to match the actual balance of private sector (96.0% of businesses) and public sector (4.0%) businesses with at least five employees, as well as the size distribution of the private sector businesses. Thus, the findings in this report are representative of U.S. businesses overall.

<u>Private Sector (Total)</u>	<u>96.0 %</u>
5 to 9 employees	46.1 %
10 to 19 employees	24.9 %
20 to 99 employees	20.9 %
100 to 499 employees	3.3 %
500 or more employees	0.8 %
<u>Public Sector (Total)</u>	<u>4.0 %</u>
<u>Total</u>	<u>100 %</u>

Attributes of the final sample were compared to the entire population of businesses with at least five employees as reflected in the Dun and Bradstreet database. The final weighted results closely match the larger population's balance of industry and sales volume, but over-represent businesses outside of metropolitan locations. The South and Midwest are also overrepresented while the West is under-represented. The few instances where the results differ by metropolitan location or region are pointed out in the text. Additional analysis of the questions where such differences occurred shows that none of the

reported results would have changed more than a percentage point had the balance by region and metropolitan location more closely represented the population.

The interviews took place between May 12 and June 13, 2005. The margin of error for overall results of the study (at the 95% confidence level) is plus or minus three percentage points.

Key Findings

Almost half of U.S. businesses report that some of their jobs could be done via telework. But the concentration of jobs involving primarily information processing or software usage implies that the potential for telework could be greater than employers recognize.

Nearly half of respondents believe that at least a small portion of their organization's jobs could be performed via telework (46%). However, only 7% believe that more than 30% of their jobs could be.

By contrast, 43% of employers say that more than 30% of their employees have jobs that require employees to spend at least half of their time using computer software applications, and 24% report that this proportion of their employees primarily process information.

Most U.S. businesses have never formally considered allowing telework, but four in ten would be likely to try telework if employees requested it.

The vast majority of businesses report that management has never held discussions about offering telework (87%). Only 7% considered offering it but decided against it.

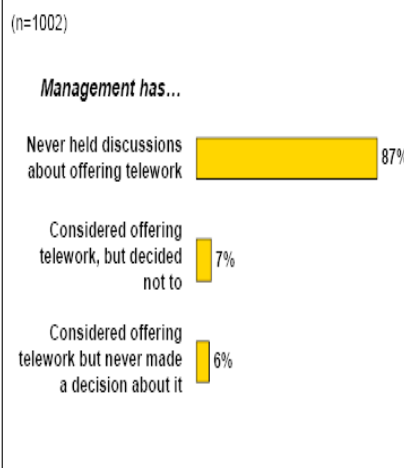
When asked how likely they would be to offer telework if employees requested it on a trial basis, four in ten report that they would be likely to say yes (42%) although only 9% are very likely.

Lack of resources to support telework act as a barrier to implementing telework, as does concern about employee productivity and supervision.

Half of U.S. businesses believe that a lack of resources would deter them from offering telework, namely the cost of needed equipment (52%) and the lack of technical support (50%). The same proportion indicates that inadequate information security would be an obstacle (52%).

Half also say that supervisory concerns—a perceived reduction in the ability to monitor employees' work (49%) and a belief that employees would be less productive off-site (49%)—are obstacles to offering telework.

Which of the following best describes discussions your company has had about offering telework?



Public sector organizations are more likely than private sector businesses to feel deterred by a lack of knowledge of how technology could make teleworking effective (53% vs. 38%).

U.S. companies with a significant proportion of jobs involving primarily information processing or software usage are also more receptive than others to telework, and encouragements to telework appear to be more effective with them than others.

Nearly half (46%) of U.S. businesses in which more than 5% of the jobs are primarily information processing would be at least somewhat likely to agree to an employee's request to telework, compared to 36% of those with fewer such jobs. Similarly, businesses with more than 5% of jobs involving at least half-time use of software applications are also more likely to agree (44% vs. 37%).

Once a business has at least 5% of their workers in information processing jobs, it is more likely to believe that some of their jobs can be done via telework.

U.S. businesses with a high concentration of jobs involving information processing or software application are much more likely to consider potential obstacles to telework to be deterrents. However, they also report that each of the possible encouragements to telework that were examined in the questionnaire would make them more receptive to telework, with the exception of being publicized as family-friendly.

Of note, information-processing jobs are more common in businesses located in metropolitan areas than non-metro areas (26% vs. 19% reporting that more than 30% of their jobs are of this type). Similarly, jobs involving at least half-time use of software applications are also more common in the metropolitan areas (46% vs. 32% with a 30% or more concentration of these jobs).

Western region businesses are particularly likely to agree to employee requests for telework.

- Over half of Western region enterprises (53%) report they would be somewhat or very likely to agree to trying out telework if an employee asked to, compared to 37% to 42% of businesses in other regions who would.
- Western businesses are also particularly likely to believe that more than 30 percent of their jobs could be performed from a home or remote location (14% vs. 6% for other regions).

Retail companies would be a less fruitful target for efforts to promote telework, because they report fewer workers who concentrate in information processing or software usage.

Aside from the few exceptions detailed in the report, businesses in the four regions of the country are quite similar to one another in their opinions on telework.

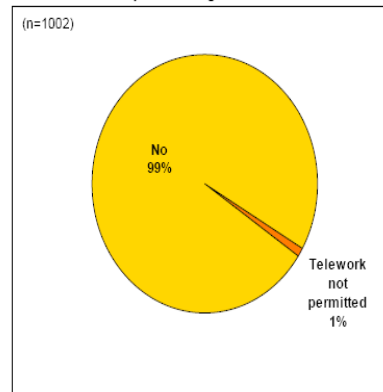
Similarly, private sector opinions do not differ greatly from those of public sector institutions, as long as the influence of the two variables which do drive many differences—business size and the proportion of jobs involving information processing or computer applications—is controlled.

Formal Policy on Telework

Nearly all U.S. businesses report that they do not have a formal policy that guides employees and supervisors in implementing telework (99%).

Only 1% say their organization's policy is to not permit telework.

Does your company have a formal policy that guides employees and supervisors in implementing telework?



Background Relating to Telework

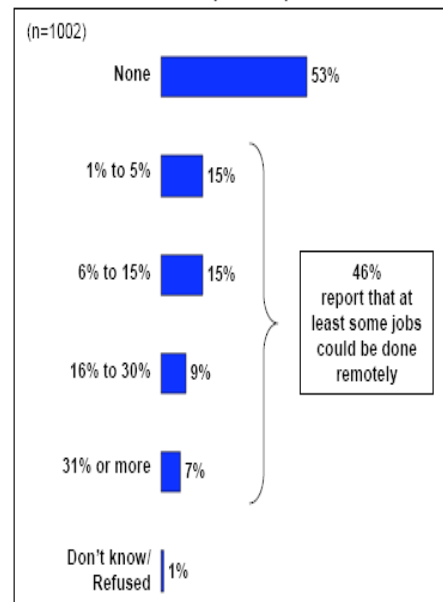
The vast majority of U.S. businesses have never considered offering telework (87%). Businesses in metropolitan areas are more likely than non-metro businesses to have held discussions about offering telework (14% vs. 9%).

Businesses with a significant proportion of information-processing jobs are more likely to have discussed telework (21%) than those with few such jobs (7%).

The service industry—which relies on information processing jobs more than other industries—more commonly reports having considered telework (18%) than retail (7%) or manufacturing (6%).

One in eight U.S. businesses have considered offering telework (13%)—7% decided against it and 6% never made a decision about it.

Approximately what percentage of your organization's jobs could potentially be performed at least part time from a home or remote location, assuming the necessary computer and communications equipment could be put into place?



Potential for Telework

Almost half of U.S. businesses indicate that some portion of their organization's jobs could be performed at least part time via telework (46%). Specifically, three in ten businesses (30%) say that 1% to 15% of their jobs could be done from home or a remote location. About one in ten (9%) believe that 16% to 30% of their organization's jobs could be performed via telework. Only 7% believe

that more than 30% of their organization's jobs could be done by teleworkers.

Half claim that none of their organization's jobs could be performed remotely (53%).

Larger businesses (100+ employees) are much more likely than smaller businesses

to believe that some workers could telecommute (69% vs. 44%), even though they are most likely to say that only 1% to 5% of workers could do so (43%).

U.S. businesses' view of the potential for telework rises once they have more than 5% of their workers in primarily information processing jobs.

Western region businesses are more likely to see a high potential for telework (more than 30% of jobs), even though they are comparable to other respondents in terms of size and the proportion of information processing jobs.

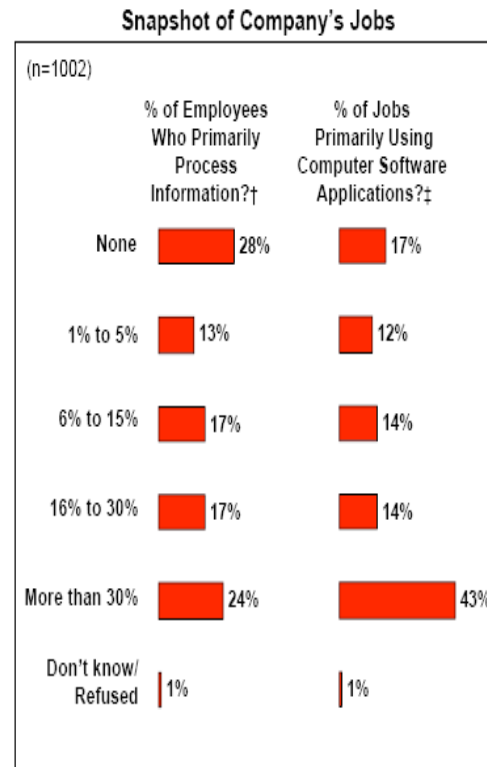
Among those U.S. businesses with less than 100 employees, public sector organizations are more likely than private sector businesses to report that some workers could telework (57% vs. 44%).

Although half of U.S. businesses claim that none of their organization's jobs could be performed via telework,

seven in ten report that at least a small percentage of their workers primarily process information (71%). An even larger majority report having some workers whose jobs require them to spend at least half of their time using computer software applications (82%).

One-quarter of U.S. businesses (24%) indicate that more than 30% of their employees primarily perform information processing, and 43% report that this notable percentage of jobs involve at least half-time use of software applications. These figures stand in contrast to the 7% of businesses who think more than 30% of their employees could potentially telework.

U.S. businesses with 100 or more employees are more likely than smaller businesses to report that at least some workers primarily process information (89% vs. 70%). However,



[†] What percentage of your company's employees perform primarily hands-on jobs and what percentage primarily process information? Examples of hands-on jobs are product development, sales, patient care and so on. Examples of information processing jobs are research, writing, communications, and so on.

[‡] What percentage of the jobs in your company require employees to spend at least half of their time using computer software applications? These include data processing, word processing, and web usage as well as using pre-programmed applications for functions such as customer service, generating reports, or other purposes.

Human Resource Management Practices

businesses of all sizes are equally likely to have more than 5% or more of workers in information processing jobs; where the large companies are distinguished from the smaller ones is in the percentage saying that 1% to 5% of their jobs are of this type (23% vs. 12%).

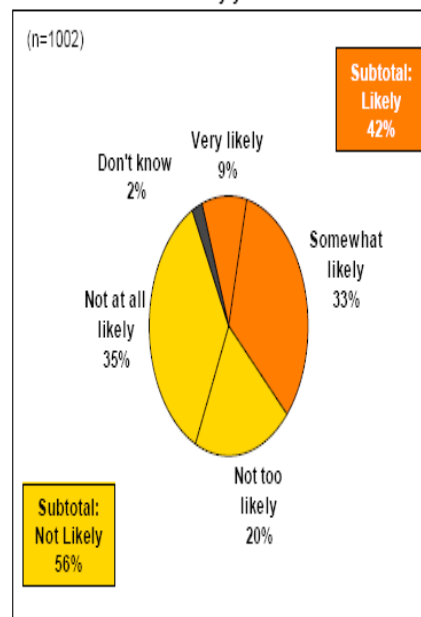
Business size also correlates with the proportion of employees who spend at least half of their time using computer applications, with 75% of the smallest businesses (5 to 9 employees) saying they have some such jobs, compared to 98% of the largest businesses (100+ employees) reporting they do.

As one might imagine, both information processing and software jobs are more common in businesses located in metropolitan areas (26% and 46% report that more than 30% of their jobs are of these types, respectively) than non-metro area businesses (19% and 32%).

Among U.S. businesses with 5 to 99 employees, those in the public sector are more likely than private sector companies to indicate that they have at least some employees who concentrate their time using computer applications (91% vs. 81%).

Four in ten retail businesses (43%) say they have no employees who primarily process information, significantly higher than 28% of businesses overall who say that is the case. Similarly, twice as many retail enterprises say none are using software applications at least half the time, compared to businesses overall (35% vs. 17%).

If some of your employees requested to telework on a trial basis, and the nature of their jobs made it feasible, how likely would your organization be to say yes?



Receptivity to Telework

When asked how likely they would be to offer telework if employees requested it on a trial basis, four in ten U.S. businesses report that they would be likely to say yes (42%), although only 9% are very likely.

Companies with at least a modest share of jobs (more than 5%) that are primarily information processing are more likely than other companies to say they would be at least somewhat likely to say yes to an employee's request for telework (46% vs. 36%) and the same holds true for companies with more software application jobs (44% vs. 37%).

Businesses in the West would be more receptive to such requests than companies in any other region (53% somewhat or very likely vs. 37% to 42% in other regions).

Smaller businesses (less than 100 employees) are more likely than larger ones to be opposed to telework; more than one-third of smaller businesses say they would be not at all likely to agree to a request to telework (36%) compared to 21% of larger companies.

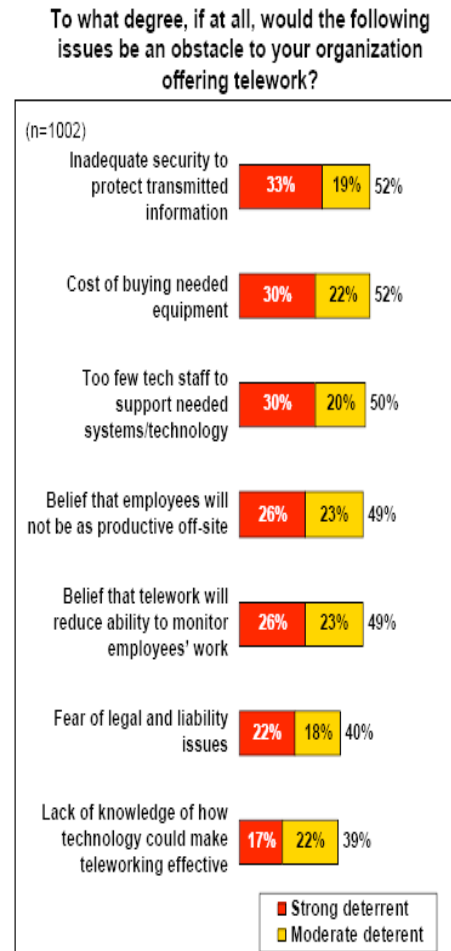
Barriers to Telework

When asked about seven potential obstacles to offering telework, over eight in ten U.S. businesses note that at least one obstacle would pose a moderate or strong deterrent for their organization (81%). In fact, six in ten businesses report that three or more of the potential obstacles would be deterrents for them (61%).

Five of the obstacles are equally strong, with about half of U.S. businesses saying they would be a moderate or strong deterrent to telework. Two relate to a lack of resources—the cost of needed equipment (52%), and the lack of technical support (50%). Two relate to concerns about employee supervision—a perceived reduction in the ability to monitor employees' work (49%) and a belief that employees would be less productive off-site (49%). Half of U.S. businesses are also concerned that security to protect transmitted information may be inadequate (52%).

Fear of legal and liability issues (40%) and lack of knowledge of how technology could make telework effective (39%) are each deterrents for about four in ten businesses.

In contrast to their greater receptivity to a trying a telework arrangement if an employee requested it, larger companies—those with 100 or more employees—are generally more likely to consider the potential obstacles examined in the questionnaire to be deterrents to telework. Since business size correlates with the percentage of information processing jobs, reports of deterrence are also higher among those enterprises with more than 30% information processing jobs. Specifically, the larger companies and those with a larger share of information processing jobs are more likely than other businesses to consider each of the following to be strong or moderate deterrents to telework:



Human Resource Management Practices

- Inadequate security to protect information
- The cost of buying needed equipment
- Too few technical staff to support systems and technology
- Belief that telework will reduce the ability to monitor employees' work.

One additional obstacle is considered to be a deterrent more frequently by businesses with more than 30% information processing jobs, although the corollary company size effect is weaker: *Fear of legal and liability issues*. For each of the seven potential obstacles considered in the questionnaire, U.S. businesses that report more than 30% of their employees spend the majority of their time using software applications are more likely than those with 5% or fewer such jobs to consider the obstacle as a deterrent.

Western region businesses are more attuned to the issue of inadequate security; 62% report it as a strong or moderate deterrent, compared to 50% to 51% in the other regions.

Public sector organizations are more likely than private sector businesses to feel deterred by a lack of knowledge of how technology could make teleworking effective (53% vs. 38%).

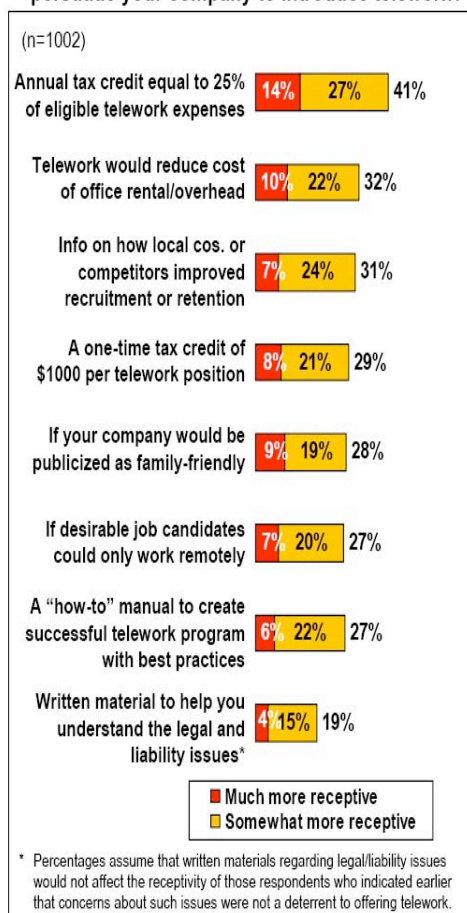
Incentives to Telework

What could be done to increase companies' interest in the concept of telework? U.S. businesses assign the highest ratings to the idea of an annual tax credit equal to 25% of eligible telework expenditures — four in ten claim this would make them more receptive to introducing telework (41%).

Other potentially effective strategies to encourage acceptance of telework include communicating how the business can benefit from telework. Specifically, three in ten report they would be more receptive to telework if it would reduce costs of office rental or overhead (32%) or improve recruitment or retention (31%).

A one-time tax credit of \$1,000 per telework position would encourage more than one in four businesses (29%), as

To what degree, if at all, would the following situations persuade your company to introduce telework?



would the opportunity to publicized as a family-friendly company (28%) and a how-to manual of best practices (27%).

Written material about liability issues would help two in ten overall (19%) and 34% of those who specifically reported that fear of liability would be a deterrent for their organization.

Just as companies with more information processing jobs are more likely to register potential obstacles as deterrents to telework, so would they be more receptive to telework if given the incentives or encouragements examined in the questionnaire. This generally holds true for each of the interventions, except publicizing the company as family-friendly.

The annual tax credit equaling 25 percent of telework expenditures is most effective for the U.S. companies that are heavily into information-processing; half (49%) of those with at least 31% of primarily information processing jobs report that this credit would make them somewhat or much more receptive to introducing telework.

Of course, both tax credit incentives have much more relevance for private sector businesses than for public sector organizations.

Interestingly, the incentives and encouragements to telework do not appear to be more effective with larger companies, even though they generally have more information processing jobs.

Private companies are more likely than public sector organizations to show increased receptivity to telework if their company would be publicized as family-friendly (28% vs. 18% somewhat or much more receptive). Services and retail enterprises are twice as likely as manufacturing companies to show increased receptivity to this publicity (32% each vs. 14%, respectively).

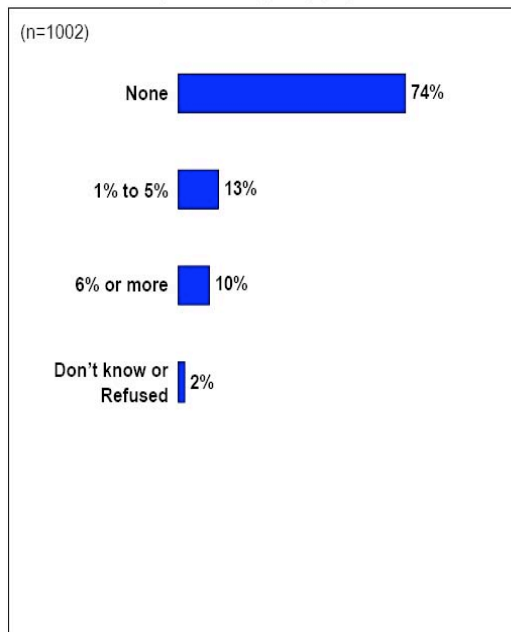
Employees With Disabilities

One-quarter of U.S. businesses interviewed report that their employee population includes people with disabilities (24%).

Specifically, 13% estimate that between 1% and 5% of their employees have some type of disability. One in ten (10%) believe that more than 5% of their employees have a disability.

The likelihood of having employees with disabilities rises with business size. Only 15% of businesses with 5 to 9 employees report having any employees with disabilities,

Roughly what percentage of your employees have any kind of disability, including any physical disabilities?



compared to 58% of businesses with 100 or more employees. [Further analysis suggests that this difference is a natural byproduct of a fairly even distribution of this low prevalence population across companies of different sizes.]

Respondent Profile

Nearly half of the responding businesses have 5 to 9 employees (47%), and almost half have 10 to 99 employees (47%). Only 5% have 100 or more employees. The data was weighted so it would match the actual distribution of businesses by size (as captured in the Dun & Bradstreet database).

Among all businesses with at least five employees, 83% of U.S. businesses are in metropolitan areas. A slightly smaller percentage of the businesses who participated in the questionnaire are in these population centers (75%).

Four in ten of the responding businesses are located in the South (41%), and three in ten are in the Midwest (30%). One in six are located in the Northeast (16%), and one in eight are in the West (12%). This sample is under-representative of U.S. businesses in the West, and over-represents those in the South and Midwest.

Two-thirds of the businesses responding have a sales volume of less than \$1,000,000 (65%), and another quarter fall into the \$1 million to \$5 million category (26%). Only nine percent had sales exceeding \$5 million.

The distribution of the respondents across industries closely matches the actual distribution of businesses with 5 or more employees.

Nearly four in ten of the responding businesses are in the service industry (38%). Two in ten fall into the retail trade category (20%). One in ten are in the manufacturing industry (10%). Fewer than one in ten are considered to be in any other industry.

(n=1002)		
	Respondents	All Business with 5+ Employees
	%	%
<u>Number of Employees (weighting factor)</u>		
5 to 9	47	47
10 to 19	26	25
20 to 99	22	22
100 or more	5	5
<u>Statistical Metropolitan Area</u>		
Metropolitan area	75	83
Non-metropolitan area	25	17
<u>Region</u>		
South	41	35
Midwest	30	23
Northeast	16	19
West	12	23
<u>Sales volume size</u>		
Less than \$1 million	65	65
\$1 million to \$5 million	26	26
\$5 million or more	9	9

S. Kintner

(n=1002)		
	Respondents	All Business with
	%	5+ Employees
<u>Major Industrial Categories</u>		
Services	38	40
Retail Trade	20	19
Manufacturing	10	8
Construction	9	10
Wholesale Trade	7	7
Finance, Insurance, Real Estate	7	7
Transportation, Communication, Electric, Gas, and Sanitary Services	4	4
Agriculture, Forestry, Fishing	2	3
Public Administration	2	2
Mining	*	*
* Less than 0.5%		

*Copies of the Preliminary Report of the findings from The WorkPlace, Inc.'s **Returning Service Members and Veterans Questionnaire on Telework 2005** will be available at the conference, or directly from the author, Susan Kintner, PhD. She can be reached at skintner@workplace.org or 203-610-8548.*

**ITA Conference Appendix to The WorkPlace, Inc.
Southwestern Connecticut's Regional Workforce Development Board**

Telework/telecommuting Pilot Research Project

**A research project funded by the Department of Labor's Office of Disability
Employment Policy**

October 2004-September 2007

1. To strengthen and explore further the findings from the “*Preliminary Report, The WorkPlace, Inc., Business Questionnaire on Telework, 2005*”, in-depth interviews were by conducted by phone with 6 employer study participants. The preliminary results are as follows:

1. Employers interviewed for the case studies all indicated a desire to learn more about Telework. Several said that while they thought Telework was a good idea in theory, they wanted more information before moving ahead to explore how it could work for them.
2. Several case study interviewees indicated that “family friendliness” was a consideration for using Telework. These included a church in Texas that is using Telework technologies to help families access their education services and talked about the potential for educational institutions of online interactive classrooms and courses for schools and learning centers and a company in Kansas that is using Telework for an employee who moved to Denver after marrying.
3. Case study participants were concerned about the cost of equipping and training workers for Telework, disruption to the current system of operations, security concerns, the usefulness of telecommuting for staff that are cross-trained and serve multiple functions and the relevance of telecommuting given onsite requirements and physical nature of some of the work.
4. Participants all indicated a willingness to discuss telecommuting if approached by employees. A critical factor for several in deciding whether to permit Telework or not was the demonstrated reliability and trustworthiness of an employee.

2. National Study of Recently Returned Service Members and Veterans with Disabilities

A subsequent national study was conducted of recently returned service members and veterans currently being treated in military hospitals for disabilities resulting from injuries sustained in the Middle East. The purpose of the study and in-depth individual interviews of 5 study participants were to learn more about service members' and veterans' with disabilities attitudes toward and interests in telecommuting as a work option and computer skills. The salient themes are as follows:

Key Preliminary National Study Findings

1. Telework appeared to a reasonable employment option from the interest and skill perspectives of the study participants for approximately 80% of the 152 person sample.
2. Working from home as compared to a telecommuting center was preferred.
3. Nearly all service members and veterans with disabilities (93%) were interested in returning to work and 75 % were very interested. Only 4 % believed that Telework would negatively impact their Veterans Administration benefits.
4. Telework had the most appeal for veterans and service members with college educations and this group appeared to be more skilled with and knowledgeable about computers.
5. The majority of the national study participants had basic computer skills and Internet access but only 50% rated themselves as highly skilled in areas other than e-mail and instant messaging.
6. Two-thirds of respondents believed they are very good or excellent at managing their time, 68% saw themselves as highly skilled at multi-tasking and 57% preferred working independently. These characteristics appeared similar to those found in the literature and prior studies of persons for whom telecommuting has worked.
7. Perceived Telework benefits for 152 service members and veterans with disabilities included saving time, saving money, feeling less stress than other employment and having more quality time with family.

Key Preliminary Case Study Findings

1. Case study participants whose work prior to being injured involved outdoor and/or physical activities would like to return to similar work if disabilities permit.
2. All indicated comfort with using computers and the Internet and several had broadband connections at home.
3. Interviewees felt their military training and work taught them how to work both as part of a group and independently and that their active military experience provided good work skills and qualities such as integrity, leadership, and ethics.
4. All five interviewees indicated a strong interest in finding work with sufficient income. Interviewees, particularly one scheduled to retire shortly and concerned about retirement earnings, perceived part-time telecommuting as a way to supplement income.
5. Interviewees' preference is for group and interactive work activity and several expressed concerns about only working from home.
6. Factors that matter to case study participants in deciding whether or not Telework would be preferable to on-site employment included the type of business, job security, work-study options and salary.

Telework & Disability: What Employers Say

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Abstract: This report summarizes the findings from a national sample of employers regarding the use of telework as an accommodation for employees with disabilities. Implications for employment interventions are described.

Keywords: Telework, telecommuting, disability, accommodation

Introduction

For many persons with significant disabilities, home-based telework offers the possibility of an accessible, barrier-free workplace, flexible scheduling and the elimination of disability-related bias or discrimination. Many people with disabilities have the desire and capabilities to work from their homes. These individuals, many with good job skills and a strong work ethic, constitute a hidden labor pool. By one estimate, increasing the availability of telework for unemployed individuals with a disability in the United States alone would save employers between \$48 billion and \$96 billion dollars annually in reduced short- and long-term disability payments, workers compensation, and personnel replacement costs. This estimate does not include the potential benefits to American taxpayers in increased tax revenues and reduced public benefits, such as Social Security Disability Insurance (SSDI), Supplemental Security Income (SSI), Medicaid, Medicare, and housing and food supplements.

On February 1, 2001, President George W. Bush announced the New Freedom Initiative (NFI), a comprehensive program to promote the full participation of people with disabilities in all areas of society by increasing access to assistive and universally designed technologies, expanding educational and employment opportunities, and promoting increased access into daily community life. Title IV Part A of the NFI proposes to increase access to telework through the following ways:

- Creating the “Access to Telework” Fund, which will provide matching funds to states to guarantee low-income loans for people with disabilities to purchase equipment to telecommute from home. Loan funds are now available in most states.

- Making a company's contribution of computer and Internet access for home use by employees with disabilities a tax-free benefit.
- Prohibiting the Occupational Safety and Health Administration (OSHA) from regulating "home office" standards.

In 2004, the Office of Disability Employment Policy (ODEP) of the U.S. Department of Labor funded three projects to conduct pilot research in the feasibility of telework as an option for veterans with disabilities and clients of Federal and state Workers Compensation agencies. These three projects designed unique methods for conducting this research. The project at Virginia Commonwealth University (VCU) proposed to obtain information from a national cohort of employers who would be conducive to both employing workers with disabilities and with using telework as an accommodation. This interim report provides a summary of this research to date.

1. Purpose

The purpose of the research was to address the following research questions:

1. What are the characteristics of employing organizations that are conducive to home-based telework as an accommodation for employees with disabilities?
2. What policies, procedures, or strategies have been instituted by those organizations related to telework, or which they are willing to institute?
3. What are the barriers that are inherent in using home-based telework as an accommodation for employees with disabilities?

2. Procedure

2.1 Sampling

The sample was solicited from the membership of the U.S. Business Leadership Network (BLN). The BLN is a national organization of employers, both public and private, of approximately 6,700 members. The U.S. BLN and its state chapters are engaged in training, advocacy, and research efforts to promote employment of individuals with disabilities. The primary method of sampling was through email solicitations, mailings, personal communications, and advertisement to the BLN member organizations. Some respondents were drawn to the questionnaire website by word of mouth advertisement from BLN respondents to other potential respondents. However, non-BLN members represent a small minority of respondents, and because they were directed to the website by BLN members, we can assume that these non-BLN respondents also employed workers with disabilities.

2.2 Questionnaire Structure

The data collection instrument was developed from focus groups of public and private employers, and was organized into three sections: (1) Respondent demographics; (2) three triage questions related to history of (a) telework, (b) hiring employees with disabilities, and (c) using telework for employees with disabilities; and (3) an in-depth questionnaire. For the purposes of this research, “telework” was defined as home-based work for some of all of an employee’s workweek. Respondents had the option of terminating the process after completing these two initial sections or proceeding to the final, more in-depth section of the questionnaire that was based on how they responded to the three triage items. For triage question 3, respondents completed the full questionnaire regardless of their answer. Although the three questionnaires varied based on the respondent’s situation, there were some consistent items across the three surveys to allow for aggregation across groups.

A total of 453 respondents from 22 states completed the initial two sections and 142 have completed one of the in-depth sections to date. The primary methodology for data collection was through a web-based interface. Respondents also had the option of completing the questionnaires by telephone if they chose to do so, or could not complete the web-based version due to technical difficulties.

3 Findings

3.1 *What are the characteristics of employing organizations that are conducive to home-based telework as an accommodation for employees with disabilities?*

Table 1 provides information from the triage questions addressing respondents’ current status regarding employees with disabilities and telework. Of the 453 respondents, nearly three-fourths (72.3%) currently had one or more employees with disabilities. This would be consistent with the sampling population, whose mission is to promote employment of individuals with disabilities. Nearly 30% of respondents had employees who telework some or all of their workweek. In addition, 12.5% had employees with disabilities who telework as an accommodation. Again, this level of accommodation is consistent with the sampling population.

Table 1. Respondents’ Current Experiences with Telework and Employees with Disabilities

Have employees with identified disabilities	72.3%
Have employees who telework	29.5%
Have employees with disabilities who telework	12.5%

Table 2 provides frequencies of respondents across types of organizations, excluding missing responses and responses of “other.” The largest group of respondents was private non-profit organizations, with approximately one-third of respondents were from government agencies. There were, however, a substantial number of organizations (191) that classified themselves as “other” without providing further explanation that would enable us to reclassify them. We have reason to believe, based on the sampling pool, that

these organizations were predominantly (1) for-profit businesses and (2) public and private institutions of higher education.

Table 2. Types of Respondent Organizations

Private Non-Profit	52.7%
Public Non-Profit	0.8%
For-Profit Business	13.8%
Local Government Agency	2.7%
State Government Agency	19.6%
Federal Government Agency	10.4%

Table 3 provides information regarding the size of the respondents' organizations. As this table shows, the largest segment of respondents was from organizations with between 51 and 100 employees. In addition, there was a sizable contingent of organizations with fewer than 15 employees who would not be subject to the Americans with Disabilities Act and would therefore not be required to provide accommodations to employees with disabilities, including telework.

Table 3. Size of Respondents' Organizations

15 or Less	6.1%
16 – 25	2.0%
26 – 50	5.4%
51 – 100	7.4%
101 – 500	43.3%
501 – 999	14.8%
1,000 to 4,999	15.2%
5,000 to 9,999	2.7%
10,000 or More	3.1%

Table 4 summarizes the types of disabilities employed at respondents' organizations. This item included common examples of each type of disability to assist respondents. These percentages are based only on those organizations that have employees with disabilities and excludes responses of "don't know." As shown in this table, nearly half of respondent organizations had one or more employees with sensory impairments, i.e., vision and hearing disabilities, and nearly half had employees with physical impairments such as back injuries, paralysis, cerebral palsy, etc. In a separate item, respondents were requested to indicate whether their employees' disabilities were work-related. Almost half (49.1%) indicated that they had only employees with non-work related disabilities, 20.0% had employees with work-related disabilities only, and the remainder (30.8%) had employees with both work and non-work related disabilities.

Table 4. Disabilities Among Respondents' Current Employees

Sensory Disabilities	48.6%
Medical or Health Impairments	35.7%
Mental Illnesses	35.7%
Cognitive Disabilities	12.9%
Physical Disabilities	47.1%

Human Resource Management Practices

Table 5 provides information regarding the types of accommodations that respondents' organizations currently had available. This item was asked of organizations whether or not they had current employees with disabilities. The overwhelming majority had sidewalk ramps, elevators, restroom accommodations, and handicapped parking spaces. These accommodations would be required for customers as well as employees, so it is not surprising that these would be widely available.

Table 5. Accommodations Currently Provided to Employees with Disabilities

Sidewalk Ramps	91.4%
Elevators	88.6%
Stairwell Chair Lifts	21.4%
Widened Hallways	64.3%
Restroom Accommodations	91.4%
Lunchroom Accommodations	62.9%
Appropriate Furniture	64.3%
Handicap Parking	92.9%
Bus Service	30.0%
Braille Materials	38.6%
Equipment for Hearing Impairments	40.0%
Large Print Materials	30.0%
Other	4.3%

3.2 What policies, procedures, or strategies have been instituted by those organizations related to telework, or which they are willing to institute?

Several items were included to assess respondents' investment in telework and willingness to accommodate home-based telework. One such item requested the locations from which teleworkers either currently work or could work. Table 6 summarizes the results from that item, excluding responses of "don't know." As this table shows, over a third of respondents indicated that employees could work from home and another third indicated that an employee could not telework from any outside location. Over half indicated that they would allow an employee to telework from either their home or a satellite location, or either one. A satellite location could include a branch office or call center.

Table 6. Locations From Which Employees Could Telework

Home	35.7%
Satellite Location	8.3%
Either	15.5%
Neither	34.5%
Other	6.0%

Respondents were also asked to indicate the types of accommodations and modifications they either currently provide or would provide to home-based teleworkers. Table 7 summarizes responses to this item, excluding responses of "don't know." No modifications were selected by even half of the respondents; however, a substantial number of respondents indicated that they were willing to provide email services, internet

connection services, and a supplementary phone line to enable a dedicated dial-up service in the home.

Table 7. Home Modifications Employers Are Willing to Provide for Teleworkers

Supplementary phone line installation	20.2%
Call forwarding	14.3%
Calling cards	4.8%
Teleconference equipment	17.9%
Videoconferencing equipment	6.0%
Pager	9.5%
Internet connection	34.5%
E-mail	42.9%
Internet messaging	10.7%
Bus service/transportation	8.3%
Computer equipment	2.4%
Other	1.2%

Three items were asked regarding restrictions on allowing employees to telework from home. Summaries of responses to those items are presented in Table 8. Nearly two-thirds (63.0%) of respondents indicated that teleworkers in their organizations were required to complete a probationary period prior to initiating a telework arrangement. In addition, over three-fourths (75.7%) indicated that teleworkers would also be required to adhere to a core work schedule of specific work hours and days when working from home. Respondents were flexible, however, with requirements for in-office work hours. Fewer than a third (32.4%) indicated that in-office work would be required, with an additional fourth (24.3%) indicating that this could be waived at the discretion of the employee's supervisor.

Table 8. Organizational Requirements for Teleworkers

	Prior probationary period	In-office work requirement	Core work schedule
Yes	63.0%	32.4%	75.7%
No	30.4%	43.2%	10.8%
Supervisor discretion	6.5%	24.3%	13.5%

Respondents were requested to indicate whether positions within their organization were pre-existing, dedicated telework positions and whether positions in their organization were converted to telework on an ad hoc basis as employee needs dictated. As Table 9 shows, most organizations (60.0%) did not have positions that were dedicated as telework, but 35% did, and another 5% were in the process of developing dedicated telework positions. Most organizations, it would appear, converted positions to telework as needs arise. It would also appear that a small percentage of respondent organizations had both dedicated telework positions and ad hoc telework positions.

Table 9. Creating Telework Positions

	Dedicated telework positions	Convert non-telework positions
Yes	35.0%	55.8%
No	60.0%	44.2%
In progress	5.0%	0.0%

Human Resource Management Practices

Respondents were provided with a menu of situations under which they would allow an employee to telework from home. Table 10 provides a summary of the responses, inclusive of respondents that have teleworkers and excluding responses of “don’t know” and items indicated by less than 2% of respondents. As would be expected from the respondent sample, the most frequently indicated circumstance was an employee with a disability; however, there were several other circumstances in which more than 10% of respondents indicated that they would allow an employee to work from home.

Table 10. Circumstances Under Which the Organization Allows Employees to Telework

Employee has a disability	23.8%
Employee does not have transportation	6.0%
Employee functions better at home	7.1%
Employee has elderly parents to care for	10.7%
Employee has sick children	13.1%
Employee has child or children with disabilities	14.3%
Employee has other family members with disabilities	7.1%
Employee has unknown family problems	4.8%
Employee just prefers to work at home	2.4%
Employee want to spend more time with family	2.4%
Employee is or wants to be pregnant	7.1%
Employee has a difficult pregnancy	21.4%
Employee wants to stay at home with pregnant spouse	6.0%
Employee wants to work alternative hours	4.8%
Employee has more advanced equipment at home	3.6%
Employee has another job with conflicting schedule	3.6%
Employee travels frequently	7.1%
Employee is a college student with a variable schedule	2.4%
Employee is frequently at doctor or therapist appointments	8.3%

3.3 What are the barriers that are inherent in using home-based telework as an accommodation for employees with disabilities?

Finally, respondents were requested to indicate barriers to expansion of telework opportunities within their organizations, selecting from a menu of options and direct entry of other barriers not listed. Table 11 provides a summary of their responses. Two barriers were indicated by at least one-fourth of respondents: (1) no need for telework positions within their organizations, and (2) telework does not fit within the structure of the organization. This table may be most informative, however, in the options that most respondents did not select. For example, the overwhelming majority of respondents did not feel that telework was a financially prohibitive option for their organization, nor did they feel that they were difficult to monitor or manage. In addition, only 6% indicated that there was not a demand for telework within their organization.

Table 11. Barriers to Expanding Telework Opportunities to Employees

Financially prohibitive	2.4%
No need for telework positions	27.4%
No demand for telework positions	6.0%
Not aware of telework possibilities	4.8%
Too difficult to manage telework positions	3.6%
Insufficient office accommodations	2.4%
Insufficient monitoring capabilities	6.0%
Telework does not fit organizational structure	26.2%
Security clearance limitations	4.8%
Other	1.2%

Discussion

The findings confirm that the respondents were generally amenable to accommodating employees with disabilities and those with other pressing needs. The high percentage that currently had employees with disabilities, the range of disabilities within their businesses, the accommodations provided, and the proportion that had teleworkers with disabilities suggest that the sample is atypical of the U.S. workforce but indicative of those organizations that would be more productive in terms of marketing telework as an accommodation for employees with disabilities.

A minority of the respondents had positions within their organization that were dedicated as telework. Most organizations that allowed employees to telework did so on an ad hoc basis as individual needs dictate. In addition, respondents appeared to be more willing to allow home-based telework when the employee already has a work history in the organization and therefore work habits and personality are known. Together, these findings bode well for Workers Compensation clients who may be using telework as a return to work strategy and for Reservists and National Guard members who are attempting to return to their pre-disability employers. However, it is not encouraging for those individuals who are currently unemployed and seeking home-based work with a new employer. Few employers appear willing to make this leap of faith with unknown risks.

Neither is it an encouraging finding that three-fourths of respondents required a core work schedule. Many individuals need to work from home due to episodic symptoms, fatigue, frequent appointments with doctors or therapists, and other reasons that require flexible scheduling, such as periods of work alternating with periods of rest or treatment.

One of the more encouraging findings relates to barriers to expansion of telework opportunities. Few respondents indicated that cost, monitoring, management, or demand issues were barriers for their organization. The two primary barriers, lack of need and telework not fitting into the organizational structure, were reported by only about a fourth of respondents.

Mitigating Risk via e-Networks

Use of Anti-Terrorist Digital Ecosystem in the Fight Against Terrorism

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Abstract: In this chapter, we propose an Anti-terrorist Digital Ecosystem (ATDES) that enables efficient terrorist identification and protection against terrorist attacks. An Anti-terrorist Digital Environment (ATDE) is designed as being populated by interconnected Anti-terrorist Digital Components (ATDC). ATDC are combined together to support collaboration, cooperation and sharing of available information between various regions, countries and even continents.

ATDC may be any useful idea that can be digitalized, transported within the ecosystem and processed by humans or by computers. The key ATDC include ID databases that contain personal records, screening components that read personal records and match them with the available information from the ID databases and machine-readable personal records. The available information is put into one big virtual database and enables matching of personal records.

If the available information is to be shared between various ID information resources, standardization of data needs to take place. Ontologies can be used for this purpose. Instantiation of the Ontology concepts result in ID Ontologies that act as personal records. Because Ontology files are machine readable, it is possible to do the matching of personal records with the available ID records from the networked ID databases and to action the results.

The significance of this research lies in the unification of the advances of the Ontology technology and Ecosystem paradigm for the purpose of creating a more secure environment in which to fight against terrorism.

Keywords: Anti-terrorism, Digital Ecosystem, Digital Environment, Digital Components, Ontology.

Introduction

Every day we are surrounded by and face problems associated with terrorist attacks. People live in fear and insecurity. This situation is unnecessary as it does not solve any problems. Moreover, it brings forth only corruption of lives and families.

People are trying to establish an active anti-terrorist community and communication routes as they are working towards the same goal. An advertisement calling against terrorism in Australia bears the title: 'Every piece of information helps'. But, how do we

determine the crucial information? There is a need to find a way to enable this crucial piece of information to be as efficiently as possible, added to the information system, processed within the system and acted upon when needed. The system needs to be designed to support collaboration and cooperation as well as sharing of the available information between various regions, countries and even continents. A support network needs to be designed that provides the knowledge and resources as well as enables dynamic interconnections among various anti-terrorist organizations.

We aim to create a software infrastructure that will enable optimal use of the available information and support efficient knowledge sharing between various organizations for the purpose of efficient identification of terrorist groups or individuals. This infrastructure will allow linking of information resources into an organizational network. In this way, information becomes easily accessed and adapted to local needs. Digital Ecosystem provides the framework which allows organizations to collaborate and promotes local and global cooperation. We aim to establish an anti-terrorist community that is supported by a strong foundation of globally interacting anti-terrorist organizations that are moving towards shared vision and are able to find mutually supportive roles.

1. Digital Ecosystem

A Digital Ecosystem is composed of various Digital Components where each Digital Component has its uniquely assigned function. Digital Components together with a Digital Environment form a Digital Ecosystem. Those Digital Components are organized and connected to each other in a way that enables the Digital Ecosystem to function most effectively. Some of those Digital Components are more important than others. Some Digital Components are crucial for the existence of the Digital Ecosystem, while others are not so important and the Digital Ecosystem can still function without them. In the nature, plants, animals, fungi and microbial organisms are living parts of an ecosystem while the physical surroundings such as minerals found in the soil are known as environment or habitat. Digital Components are analogous with plants, animals, fungi and microbial organisms while the Digital Ecosystem is analogous to the ecosystem. A Digital Environment is analogous to environment or habitat.

A Digital Ecosystem captures the essence of the classical complex ecological community in nature. Digital Organisms (such as software or database applications, analogous to biological organisms) together with a Digital Environment (analogous to the biological environment) form a dynamic and interrelated complex Digital Ecosystem. A Digital Ecosystems transpose mechanisms from living organisms like evolution, adaptation, autonomy, viability and self-organization to arrive at novel knowledge and architectures [1].

Digital Ecosystem is a dynamic, complex and adaptive system composed of interrelated parts. It interacts with its environment and is subject to resulting feedback effects. A Digital Ecosystem evolves over time adaptively to fit the pressure imposed on it.

A Digital Ecosystem transcends the traditional rigorously defined collaborative environments, such as centralized (client-server) or distributed (such as peer-to-peer)

models into agent-based, loosely coupled, domain-specific and demand driven interactive communities which offer cost-effective digital services and value-creating activities that attract agents to participate and benefit from it [2].

A Digital Ecosystem is defined as a self-organizing digital infrastructure aimed at creating a digital environment for networked organizations that support the cooperation, knowledge sharing, and development of open and adaptive technologies [3] and evolutionary domain knowledge rich environments [2].

The Digital Ecosystem infrastructure is a Digital Environment which is populated by Digital Components [4]. A Digital Component is any useful idea that is expressed by a formal or natural language. This idea is digitalized and transported within the ecosystem, and can be processed by humans or by computers. A Digital Environment evolves and adapts to local conditions through the recombination and evolution of its Digital Components.

A Digital Ecosystem can be specifically developed for an anti-terrorist community, where species in the ecosystem such as various information resources and associated applications act as Anti-terrorist Digital Components that populate Anti-terrorist Digital Environment.

2. Anti-terrorist Digital Ecosystem (ATDES)

We believe that an anti-terrorist community can be supported through optimal use of the available information and linking this information to the personal machine-readable records. The information resources can be networked using a Digital Ecosystem paradigm. A network of various information resources that contain personal machine-readable information can be designed and implemented to create a Digital Ecosystem. Such an organization network may activate a virtuous circle through dynamic integration of several components that are provided by different information resources scattered around world.

We propose an Anti-terrorist Digital Ecosystem (ATDES) as Anti-terrorist Digital Environment (ATDE) populated by Anti-terrorist Digital Components (ATDC). We believe that ATDE may be prototyped on a small region but should eventually be spread globally. ATDC may include various components but the key components should be:

- ID databases that contain personal information, criminal records and related information (ATDC1)
- screening components that read personal records and match them to the available information from the ID databases (ATDC2)
- machine-readable personal records (ATDC3)

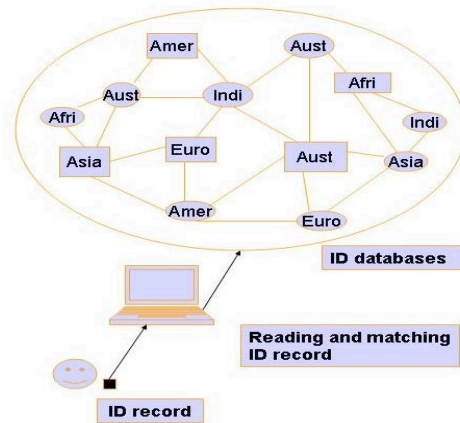


Figure 1. Anti-terrorist Digital Components (ATDC)

In Figure 1, we show the three main components of the ATDES. Different information resources from different parts of the world form a network of interrelated parts. This network is conceptually regarded as one big information resource that contains personal records of all humans inhabiting our planet. We call this component ATDC1. The second ATDES component (ATDC2) reads personal records and matches this data with personal records from the networked information resources. It is needed to place a huge number of ATDC2s in order to establish a more controlled environment. Each person carries its machine-readable personal record. This is ATDC3 that is read by ATDC2 and matched against data from ATDC1.

3. Use of Ontology within ATDES

If the available information is to be shared between various information resources, standardization of data needs to take place. Ontologies can be used for this purpose. Moreover, the use of ontologies adds semantics to the model and enables meaningful interpretation of the data.

ID Ontology can be used to keep personal information in a comprehensive format. Instantiation of the ID Ontology concepts results in specific ID Ontologies that act as personal records. Personal records from ATDC3s as well as personal records from ATDC1s are kept in the format of ID Ontology.

In Figure 2, we show ID Ontology that can be used to represent knowledge about a person. Concepts and relationships between those concepts need to be precisely defined and assembled together to uniquely describe a personal record. Assigning values and attributes to the concepts of the ID Ontology will then result in instantiated ID Ontology or personal records that uniquely describe a person.



Figure 2. Use of ID Ontology to define personal records

We propose Onto-agents as Ontology-based intelligent leading software species that have strong reasoning capabilities which can manage, coordinate and collaborate between ATDCs. Onto-agents commit to the common ID Ontology. This means they obey the agreement with respect to the semantics of the concepts and relationships defined in the ID Ontology and agree to use the shared vocabulary in a coherent and consistent manner [5]. Because Ontologies are stored as machine-readable files, Onto-agents can read personal records defined as ontology files in ATDC3s, do the matching with the available ID records defined as ontology files in networked ID databases (ATDC1s) and to take actions according to the results.

4. Digital Ecosystem and Ambient Intelligence

Ambient Intelligence (AmI) refers to digital environments that are sensitive and responsive to the presence of people [6]. This interaction between human beings and digital information technology can be established through ubiquitous computing devices such as sensors for shape, movement, scent or sound recognition [7]. AmI requires convergence of

several computing areas such as ubiquitous computing, intelligent systems, transparent technologies, context awareness and social interaction of objects in the environment [8].

The purpose of Digital Ecosystems design and use is very similar to the purpose of creation of Ambient Intelligence. Progress in Aml technologies results in development of better Digital Ecosystems, and vice versa. Those two approaches are sharing the same vision but are taking different points of view. They are highly related and interconnected but show some differences.

To explain the differences, we will take the example from nature. On a tropical island, we may have a rain forest ecosystem, a mangrove swamp ecosystem along the coast and an underwater coral reef ecosystem. Analogously, within an Intelligent Ambient, we may have three different Digital Ecosystems. The three ecosystems of a tropical island are integrated into one big Tropical Island Ecosystem and this ecosystem is further integrated with other ecosystems on our planet Earth to form a mega Earth Ecosystem. Analogously, it is most probable that two separate Digital Ecosystems may need to be integrated in order to enable effective cooperation and knowledge sharing.

Another example: the Intelligent Ambient of a train station can be established through networks of various Digital Components. Each Digital Component belongs to one of the three Digital Ecosystems. One Digital Ecosystem controls if the passengers have the correct train tickets (Ticket Control Digital Ecosystem), the second Digital Ecosystem may be designed to inform passengers about available train services (Information Digital Ecosystem) and the third Digital Ecosystem can be the one we proposed in this chapter (Anti-terrorist Digital Ecosystem). The whole ambient is intelligent and the three different ecosystems are making part of it. Machine readable personal records can be designed in such a way that it integrates data needed by each of the three different Digital Ecosystems. In this way, this personal record could be read and understood by Digital Components of each of the three different Digital Ecosystems (Ticket Control, Information and Anti-terrorist).

The integration process of Digital Ecosystems may continue and eventually, all Digital Ecosystems of various domains will form a mega Digital Ecosystem analogous to the Earth Ecosystem. However, this integration process of Digital Ecosystems is not an easy task. Having this vision of our future and being aware of the advantages of this integration as well as the problems associated with this integration process, it is best to design a Digital Ecosystem based on the latest technologies which would enable their easy integration.

Discussion and Conclusion

We proposed an Anti-terrorist Digital Ecosystem (ATDES) to protect people from terrorist attacks and innocent sufferings. This organization network activates a virtuous circle through dynamic integration of three key Anti-terrorist Digital Components (ATDCs): ATDC1 component embraces different information resources scattered around world that contain personal records, ATDC2 component reads personal records and matches this data with personal records from ATDC1, and ATDC3 component has machine-readable personal records that need to be matched against the information available in ATDC1. We

use ID Ontology to keep personal information in a comprehensive format. Instantiation of the ID Ontology concepts results in specific ID Ontologies that act as personal records.

The significance of the research lies in the unification of the advances of the Ontology technology and Ecosystem paradigm for the purpose of creating a more secure environment.

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SMEs, Electronically-Mediated Working and Data Security

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Abstract: Security of data is critical to the operations of firms. Without the ability to store, process and transmit data securely, operations may be compromised, with the potential for serious consequences for trading integrity. Thus the role that electronically-mediated working plays in business today and its dependency on data security is of critical interest, especially in light of the fact that much of this communication is based on the use of open networks (i.e. the Internet). This chapter discusses findings from a ‘WestFocus’ survey on electronically-mediated trading and ‘offsite working’ (or telework) amongst a sample of SMEs located in West London and adjacent counties in South-Eastern England in order to highlight the problems that such practice raises in terms of data security policy. Data collection involved a telephone survey undertaken in early 2006 of 378 firms classified into four industrial sectors (‘media’, ‘logistics’, ‘Internet services’ and ‘food processing’). After establishing how ICTs and the Internet are being exploited as business applications for SMEs, data security practice is explored on the basis of sector and size with a focus on ‘offsite working’. The chapter goes on to highlight areas of concern in terms of data security policy and practice. Findings show the effect of sector and size influences.

Introduction

One particular consideration that firms must account for whilst engaged in electronically-mediated working is security. Any standard text will argue that a security system can only be as strong as its weakest link. In a field that is notoriously difficult to obtain authoritative data, the WestFocus research project ‘ICT adoption and use by SMEs’ reported on in this chapter attempted to gain empirical evidence on *inter alia* the manner in which SMEs balance security considerations with networked working and trading.

Data security is defined by NISS [1] as “protection of data from unauthorized (accidental or intentional) modification, destruction, or disclosure”. McLeod and Schell [2] maintain that data security requires three aspects to be maintained: integrity (i.e. providing an accurate representation of the physical reality that data represents); availability (i.e. allowing those authorized to have access to data); and confidentiality (i.e. the protection of data and information from disclosure to unauthorised persons). Without the ability to store, process and transmit data securely, operations may be compromised for which there may be

serious detrimental consequences for trading. Thus the role that electronic communications play in business today and its dependency on data security is of critical interest, especially in light of the fact that much of this communication is based on the use of open networks manifest in the Internet, a technology that was originally designed for research rather than e-commerce [3]. Spinellis *et al.* [4] argue that advanced technology has in many cases outpaced the development of ‘control practice and employee knowledge’ to create significant security risks. Additionally, authors such as Nah *et al.* [5] assert that firms need to develop e-business processes that span more than one organisation in order to maintain a competitive edge. Add to this an expectancy that individual employees should have ubiquitous access to a firm’s information systems whether onsite or offsite, then it becomes clear that data security is an increasingly complex issue.

While much of the academic literature focuses on large firms, however, much less is evident on the experiences of SMEs in terms of ICT usage [6, 7] or on the emergence of networked trading which proponents argue is becoming the dominant commercial paradigm [8]. Clear evidence of how small and medium-sized enterprises (SMEs) exploit ICTs and the Internet, and the consequential threats to data security, need to be continually updated if policy makers, technology providers and SMEs themselves are to work with the world as it really is, rather than as it is portrayed by, for example, technology providers who tend to overstate threats in order to sell their wares, perhaps causing “firms (to) continue to choose technologies which may not be very effective for their environment” [9, p. 307].

There are over 4 million enterprises in the UK [10]. The majority of these - nearly 3 million - are ‘one-man-bands’ (i.e. they have no employees) leaving around 1.1 million which have employees. Further breakdown shows that 960,000 have between one and nine employees (constituting ‘micro firms’), 160,600 have between 10 and 49 employees (‘small firms’), 26,000 have between 50 and 249 employees (‘medium-sized firms’) and just over 6,000 have over 250 employees and above (‘large firms’). Thus SMEs - firms with between 0 and 249 employees - account for over 99 percent of all businesses in the UK, and thus have a significant role to play in the UK economy [11]. For the purposes of this study however, firms with no employees (i.e. single operators or ‘one-man-bands’) have been excluded. Exploration of sector and size differences will be undertaken therefore on the basis of firms with employees only.

The structure of the chapter begins with a review of the literature, followed by an introduction of the WestFocus research project and methodology. Next research findings are set out, beginning with data on how ICTs and the Internet are being exploited by the SME sample in inter-firm trading. After setting out the general e-trading background for the sample as a whole, the discussion moves on to consider ‘offsite working’ or ‘telework’ with sector and firm size comparisons, followed by consideration of security policy and practice, again based on sector and size data. Then come concluding remarks which, amongst other aspects, will highlight concerns in regard to data security.

1. Literature Review

There is a small but growing literature on e-business adoption taking a small firm perspective that then contains discussion on security risks. Much of this discussion is couched within examinations of barriers to e-business [7, 12, 13, 14, 15, 16, 17, 18, 19]. Examining the literature on the area, Dixon *et al.* [7] identify common aspects in relation to e-business adoption barriers. Concerns for security and privacy is one such in a list that also contains a generalised lack of awareness of the potential of ICT, a lack of an IT skills base, concerns for high initial set-up costs, and a lack of staff to implement ICT. Nevertheless MacGregor and Vrazalic [19] find the security risk taxonomies of Van Akkeren and Cavaye [15] and Quayle [17] “manufactured” (p. 511) and reflections of research design rather than reality.

Researchers note the heterogeneity of SMEs [6, 7, 20], and sector and size examinations have been made of SME ICT and e-business adoption. Results are conflicting in places. Simpson and Docherty [21] find sector to be a significant factor in e-business adoption and Martin and Matlay [6] observe that a micro-business focusing on business services is more likely to adopt ICT than a similar-sized manufacturing firm. Levy and Powell [22] on the other hand find little evidence on the basis of sector for differential patterns in ICT adoption. Similarly, Van Beveren and Thompson [15] and Daniel and Myers [23] argue that firm size is a significant factor in e-business adoption while Levy and Powell [22] argue, in relation to ICT adoption, that size is not significant.

From an intra-firm and ‘distributed working’ or ‘telework’ perspective, there is still however a paucity of in-depth research into data security *per se* let alone from a small firm view. No literature citing size and sector differences in relation to security is cited here therefore. Aside from arguments on its efficacy, much writing on telework examines management issues raised by telework or, as with e-business adoption, examines barriers inhibiting its adoption. Typical of the latter is a study by Lim and Teo [24] who spend one paragraph discussing the risk of confidential data loss as the result of teleworking. In much of this literature, however, security is hardly mentioned or at best is treated in a ‘high level’ manner. One with a more definitive focus on data security in telework however is Sturgeon [25] who identifies issues such as individual teleworkers handling sensitive from home, and argues for risk assessment procedures for telework. In a series of sometimes dated recommendations Nilles [26] argues for strong methods of user authentication and for network design principles that reflect a heterogeneity of access modes. Rikitake *et al.* [27, 28, 29] examine data security issues raised by technologies such as WLANs, teleconferencing, P2P and VoIP in telework. They point, for example, to the risk of other family members using the same home PC and accessing, perhaps, Peer-to-Peer (P2P) networks which are known to be risky due to the possibility, they imply, of picking up computer viruses and other ‘malware’ [27]. A US government-sponsored study [30] on telecommuting points to vulnerabilities in, amongst others, wireless networking, printing software and web browsers.

More typical of the literature then are studies on telework which have distinct foci other than security, but which note data security vulnerabilities as part of their examinations. Thus Fulton *et al.* [31] in a study on ‘home-based e-work’ that examines the

blurring of home and work boundaries identify the shared use of home PCs as being a source of risk for data security. Tremblay [32] explores work-life balance issues, but points to the dissatisfaction expressed by teleworkers of cumbersome security procedures. An Australian study [33] notes security issues raised by outsourcing and the development of a globalised service sector workforce. They go on to promote the use of 'ethical hackers' who can be employed to test network defences. Illegems and Verbeke [34] argue that one of the factors militating against telework adoption is that it 'hinders the security of internal data' (p. 79) with two possible forms of unauthorised access defined: industrial espionage and intrusion by employees. They also argue that any form of telework implementation that leads to employees becoming self-employed freelancers will raise the level of risk to internal data as loyalty to their firm will diminish. Tran and Atkinson [35] argue that privacy and security processes are required for multinational firms transferring data across international borders. Given the complexities of the issues inherent in the protection of data security, Lohmeyer *et al.* [36] argue that IT departments should employ managed security providers (MSPs) to help them face security challenges online.

There are a number of guides offering advice on 'good practice' in relation to data security. Thus Huws and Podro [37] argue that teleworkers should be fully trained in to protect data security by use of anti-virus software, passwords and back-ups of work-in-progress, and that if such training were not forthcoming, then teleworkers should not be held responsible for losses of data. The 'UK Online for Business' publication 'Working Anywhere' [38] which in a section devoted to data security argues that safe data handling is dependant not just on technical measures and procedures but also on reliable and vetted staff. Kuhn *et al.* [30] argue that telecommuting users working for federal bodies should be given guidance on selecting appropriate technology, software packages and tools.

However these authors are not reporting on small firms *per se*, and thus there is a large hole in the literature in these terms. Afterall, small businesses are not simply scaled-down versions of large businesses [17, 37]. For any theory on SMEs to be relevant, consideration of their "motivations, constraints and uncertainties" [p. 18] must be made which are different in comparison to their larger cousins [39]. Thus Spinellis *et al.* [4] note that the use of networked IS within small businesses and home offices can be the source of serious security problems because typically they lack the technical expertise and resources to create and maintain a desirable level of security. Gupta and Hammond [9] observe that 49% of organisations in the U.K. see budget constraints as having some primacy over computer security implementation.

Schneier [40, 41] (cited in Walden [42]) argues that data security issues are not given adequate attention or are not properly understood in many organisations. Ignoring internal threats, Nilles [26] argues, tongue-in-cheek, that "sensitive company information is easiest to protect from outside intruders if it is kept securely locked in the company's vaulted, main office computers with no access allowed from the outside" (p. 83). In a networked electronic world of course such a stance would be untenable. So firms, whatever their size, are obliged to take steps to protect the security of their installation and of their data. Higgins [43] thus observes, "a policy is the start of security management" (p. 217) and that "Effective security management ... is based on the systematic concept, dissemination and operation of an information security policy". In the absence of such a policy, businesses

may be seen as vulnerable, whether as the result of accident or malevolence. So having a policy suggests that at least some appraisal has been made of potential security threats, however imperfect.

Given the paucity of empirical data on the data security risks faced by SMEs in an electronic realm, some of the analysis from the bi-annual DTI Information Security Breaches Surveys of 2004 [44] and 2006 [45] is included in Table 1. This data is based on a sample of 1,001 firms of all firm sizes including large firms. The evidence from these surveys highlight a relatively variegated picture of threats to data security: ‘virus infection and disruptive software’ and ‘theft and fraud involving computers’ have decreased in incidence after a hiatus in 2004; ‘staff misuse of information systems’, and ‘unauthorized access by outsiders (including hacking attempts)’ increased from 2002 to 2004 but have more-or-less plateaued after this; and ‘systems failure or data corruption’ have increased in incidence (given there is missing data for 2002). Setting these figures against the fact that volumes of electronically-mediated trading are increasing year-on-year [46], some succour may be derived by the lack of definitive evidence for sharp increases in security breaches.

Table 1: Type of Security breach suffered by UK businesses in 2002, 2004 & 2006			
Type of Breach	2002 Survey	2004 Survey	2006 Survey
Virus infection and disruptive software	41%	50%	35%
Staff misuse of information systems	11%	22%	21%
Unauthorised access by outsiders (including hacking attempts)	14%	17%	17%
Theft or fraud involving computers	6%	11%	8%
Systems failure or data corruption	N/A	27%	29%

Source: DTI Information Security Breaches Surveys 2004 and 2006

Questions of data security are raised too as a result of differing modes of access (fixed versus wireless) and in terms the variegation of devices (including PCs, personal digital assistants (PDAs) and mobile phones/cell phones). Nevertheless, whatever the technologies and use of protocols that may protect data security whilst in transit across electronic networks, Gordon argues that “If employees can walk out of the door of those organizations with reports, drawings, diskettes, files, and anything else in their pockets or briefcases (as they almost always can), then it’s incorrect to say that telecommuting presents a new and different risk” [47]. Human factors are important argues Lundegaard as “Disruptions of information systems are mostly a result of human error, ranging from system integration mistakes to accidental cutting of fibre optic cables, and natural disasters...” [48]. Thus Reuvid [49] argues that management controls and processes overseeing security are critical factors for firm survival.

2. Methodology

The research is based on a two-stage approach to data collection. The first stage is a telephone survey of 378 firms in four sectors in a region bounded by West London boroughs and adjacent counties. This involved a structured questionnaire of 51 questions which besides collecting data on security issues, also gathered information on ICT strategy, implementation, investment and training. The four industrial sectors examined here are: Media, Transport and Logistics, Internet services, and Food processing. The telephone survey took between 15 to 20 minutes to complete. A certain number of survey interviews were only partially completed, and these have been removed to create a final sample of 378 interviews.

Univariate analysis using SPSS was undertaken of the WestFocus dataset by use of frequency distributions for the whole dataset and by use of cross-tabulations of data by sector and size. The chi-squared test is applied to these cross-tabulations, and the significance measure is displayed under the different tables. Note that where the chi-square test shows a lack of significance, then these findings go unreported in this chapter.

According to an European Commission [50] definition, a Small and Medium-sized Enterprise (SME) has between zero and 249 employees, has a turnover of less than 50 million Euros, and is no more than 25% owned by a non-SME (not including banks or venture capitalists). Due to difficulties in establishing ownership patterns, and getting accurate turnover data, one limitation of the empirical work in this chapter is that data has been gathered on firms on the basis of employee numbers only.

As can be seen in Table 2 which shows breakdown of the survey sample by size and sector, the sample is composed of 100 firms from the 'Logistics' and 'Food Processing' sectors, 90 firms from the 'Media' sector, and 88 firms from the 'Internet Services' sector, making 378 firms in the dataset as a whole. By size the sample is composed of 205 'micro firms' (1-9 employees), 140 'small firms' (10-49 employees) and 33 'medium-sized firms' (50-249 employees). The fact that there are only three 'medium-sized firms' listed in the media sector is a limitation in the research cited in this chapter as cross-tabular analysis by size and sector using data in which the frequency in any cell is less than five invalidates the chi-square test.

<i>Table 2: Survey Sample Breakdown by Size and Sector</i>					
		Firm Size			
		Micro	Small	Medium	Total
Sector	Media	60	27	3	90
	Logistics	49	38	13	100
	Internet Services	49	34	5	88
	Food Processing	47	41	12	100
Total		205	140	33	378

3 Findings

The data shown in this section show various findings from the survey. Some of the data is shown on the basis of the whole sample, while other data is shown with breakdown by sector and size.

3.1 Technology Use

<i>Table 3: Technology Use</i>	<i>%</i>
Email	99%
Internet	99%
Company Website	84%
Intranet	40%
Extranet/EDI	31%
Own computer network (LAN/WAN)	86%
Wireless access	53%
Groupware	23%
Video/audio-conferencing	27%
Broadband	84%
Firewall	93%
Anti-virus software	96%

Table 3 shows frequency data for technology use for the whole sample. Email (99%) and Internet (99%) use are practically ubiquitous, followed closely by anti-virus software (96%) and a firewall (93%). Thus the basic infrastructure for secure distributed working and electronically-mediated trading is in place for the sample as a whole. Use of broadband (84%) is also high, as the figure for wireless access (53%). Both of these technologies are noted in the literature as possible areas of vulnerability in terms of data security, though given the high level of anti-virus software and firewalls evident in this data, firms in the sample as a whole appear to be well-protected. A limitation of the data is that evidence that might contradict this picture such as whether firewalls are misconfigured and the level of currency of anti-virus software (.i.e. how up-to-date it is) was not obtained as part of the survey. Additionally this data is obviously based at the level of the firm and does not account for practice by individual employees. Other technologies of note in terms of distributed working are video/audio-conferencing groupware – used by 27% of the sample – and groupware – used by 23%.

3.2 Internet Use

Table 4 shows frequency of response to the question, “Do you the Internet to...?” (and individual options shown in the table) for the sample as a whole. According to these figures

it is arguable that ‘networked trading’ is an established phenomenon in supply chains with customer-facing (downstream) use being more prevalent than supplier-facing (upstream) use. 67% of the sample use the Internet to share information with customers and 53% use it to share information with suppliers. Figures for trading are 58% and 50% respectively in terms of customers and suppliers. A surprising finding is the relatively high level of the use of the Internet to make payments, with 61% of firms receiving payment from customers and 56% of firms making payment to suppliers. Notably 44% of firms use the Internet to work with other firms on collaborative ventures which is arguably of equivalence to ‘distributed working’.

Table 4: Use of Internet	%
Share information with customers	67%
Share information with suppliers	53%
Trade with customers	58%
Trade with suppliers	50%
Receive payments from customers	61%
Make payments to suppliers	56%
Work with other firms on collaborative ventures	44%

3.3 Collaborative Working and Internet Use by Sector

Further to the discussion above, Table 5 shows a cross-tabulation between frequency of response to the question, “Do you use the Internet to....?” and the option “....work with other firms on collaborative ventures” and sector. ‘Internet Services’ scored highest with a frequency of 64 ‘yes’ responses (73% by sector), followed by ‘Media’ with 46 (51% by sector), then ‘Logistics’ with 30 (30% by sector) and finally ‘Food Processing’ with 26 (26% by sector).

Table 5: Use of the Internet to work with other firms on collaborative ventures and Sector				
		Response		Total
		Yes	No	
Sector	Media	46 (12.2%)	44 (11.6%)	90 (23.8%)
	Logistics	30 (7.9%)	70 (18.5%)	100 (26.5%)
	Internet Services	64 (16.9%)	24 (6.3%)	88 (23.3%)
	Food Processing	26 (6.9%)	74 (19.6%)	100 (26.5%)
	Total	166 (43.9%)	212 (56.1%)	378 (100%)

Chi-square significance: .000

3.4 Online Trading

Table 6 shows frequency of response for the whole sample to the question, “What proportion of your total sales come from online orders?” Given that 10% of the sample ‘don’t know’, at least 43% of the sample make no online orders at all, and thus at least 47% of the sample get some proportion of their sales from online sources. At least 18% of the sample derive more than 25% of their total sales online.

Table 6: Proportion of total sales from online orders	%
None	43%
1-5%	16%
6-25%	13%
26-50%	5%
51-99%	5%
100%	8%
Don’t know	10%

Table 7: Proportion of supplies ordered online	%
None	34%
1-5%	36%
6-25%	10%
26-50%	9%
51-99%	14%
100%	3%
Don’t know	6%

Table 7 shows frequency of response for the whole sample to the question, “What proportion of your supplies do you order online?” Given that 6% of the sample ‘don’t know’, at least 34% of the sample make no online orders at all, and thus at least 60% of the sample use online sources to order some proportion of their supplies. Only 3% order all their supplies online. On the basis of the data for online sales and ordering, electronically-mediated trading or e-commerce still appears to be emergent rather than pervasive.

3.5 Challenges for firms undertaking e-commerce

Following on from the findings on electronically-mediated trading, discussion moves to the challenges that SMEs face in terms of the challenges that such trading brings in its train for firms. Table 8 shows frequency of response for the whole sample to the question “Have you experienced any of the following challenges in developing e-commerce for your business?” As surveyed firms could respond to more than one of the options offered, the data is not mutually exclusive. Of greatest relevance to the concept of ‘distributed trading/working’ are the responses ‘Customers do not want to change’ (19%), ‘Suppliers are not ready for electronic business’ (10%) and ‘Difficulties with information sharing in collaborative

ventures' (8%). For those promoting the greater use of electronically-mediated trading, such data must offer succour given the relatively low response rate for these challenges as a whole. From the data security perspective, the responses 'Security failures / problems' (6%) and 'Internet fraud' (8%) are most relevant. Though not identical in description, this latter finding chimes with the "Theft or fraud involving computers" finding from the DTI security breaches survey of 8% [45]. Again such findings will offer succour to promoters of electronically-mediated trading. However, as implied above, getting good data on security issues is a difficult process so these figures should always be approached with caution.

Table 8: E-commerce challenges	%
Customers do not want to change	19%
Difficulty in hiring staff with appropriate IT skills	13%
Difficulty in getting good technical advice from outside	15%
Suppliers are not ready for electronic business	10%
High costs to develop / maintain the web site	14%
High connection costs	8%
Security failures / problems	6%
Internet fraud	8%
Difficulties with information sharing in collaborative ventures	8%

3.6 Remote Access to a firm's systems / databases

Table 9: Remote Access to a firm's systems / databases by customer, supplier and joint venture partner	
Trading partner	%
Customers	42 (11.1%)
Suppliers	21 (5.6%)
Joint venture partners	17 (4.5%)

As numerous commentators including Ratnasingham [3] would argue, trust is a vital element in the take-up of electronically-mediated trading. Allowing access by trading partners to a firm's systems requires, arguably, a high level of trust on the part of the 'provider' to the 'user' [8]. Table 9 shows frequency of response to the question "Do you allow remote access to your systems / databases by customers / suppliers / joint venture partners?" Percentages of firms in terms of the whole sample are shown in parentheses, and the options of 'Customers', 'Suppliers' and 'Joint venture partners' are not mutually exclusive. Only 42 (11.1%) of the sample allow customers remote access with 21 firms (5.6%) allowing such access by suppliers and 17 firms (4.5%) doing so by joint venture partners. The figures are too low for meaningful statistical examination by size or sector. Thus the overwhelming majority of firms in the survey sample do not allow trading partners, whether customers, suppliers or joint venture partners, to have remote access to their systems. While these findings do not in themselves shed light on the issue of trust and any inherent data security risks whilst working in an electronic realm, or, for that matter, on

the availability or otherwise of appropriate and cost-effective technology, this data does suggest that close electronic working across supply chains as propounded by writers such as Straub [8] is still rare amongst SMEs.

3.7 Offsite Working / Telework

Table 10: 'Offsite Working' by Sector

	Sector				
	Media	Logistics	Internet Services	Food Processing	Total
'Yes'	40 (10.9%)	37 (10.1%)	69 (18.8%)	41 (11.2%)	187 (51.0%)
'No'	48 (13.1%)	62 (16.9%)	15 (4.1%)	55 (15.0%)	180 (49.0%)
Total	88 (24.0%)	99 (27.0%)	84 (22.9%)	96 (26.2%)	367 (100%)

Missing: 11 Chi-square significance: .000

After setting out the general e-trading background for the sample as a whole, at this point the discussion moves to the consideration of 'offsite working' or 'telework', and sector and firm size comparisons. Table 10 shows a cross-tabulation between frequency of response to the question, "Do any of your company's personnel work offsite with access to your information systems (or 'telework')?" and sector. Percentages of the sample are shown in parentheses. The question was so framed in order to avoid possible confusion over sole use of the term 'telework' which the author had experienced in previous research on the subject [51]. Arguably working offsite 'with access to (...) information systems' is a reasonable synonym for 'telework' in any event. In terms of the whole sample, 51% responded in the affirmative to the question. However when cross-tabulating with 'sector', for three of the four ('Media', 'Logistics' and 'Food Processing') the proportion of firms denying having 'offsite working' in these terms was greater than those having it, with responses of 45%, 32% and 43% respectively. Only 'Internet Services' had a greater proportion of 'offsite working' (82%) than not.

Table 11: 'Offsite Working' by Firm Size

	Size			
Response	Micro	Small	Medium	Total
Yes	83 (22.6%)	78 (21.3%)	26 (7.1%)	187 (51.0%)
No	117 (31.9%)	58 (15.8%)	5 (1.4%)	180 (49.0%)
Total	200 (54.5%)	136 (37.1%)	31 (8.4%)	367 (100%)

Missing: 11 Chi-square test: .000

Table 11 shows a cross-tabulation between frequency of response to the question, "Do any of your company's personnel work offsite with access to your information systems (or 'telework')?" and firm size. Percentages of the sample are shown in parentheses. There is a relatively low number of 'medium-sized firms' in the sample (31) in comparison to 'small firms' (136) and 'micro firms' (200), and this makes overall comparison statistically weak. Nevertheless if we accept this as a limitation, then on the basis of the data obtained, there is

a size effect evident. 42% of ‘micro firms’ have ‘offsite working’ while the corresponding figures for ‘small firms’ and ‘medium-sized firms’ are 57% and 84% respectively.

3.8 Written Security Policy

Table 12: Written Security Policy by Sector

	Sector				
	Media	Logistics	Internet Services	Food Processing	
Yes	27 (7.3%)	32 (8.6%)	46 (12.4%)	44 (11.8%)	149 (40.1%)
No	62 (16.7%)	67 (18.0%)	40 (10.8%)	54 (14.5%)	223 (59.9%)
Total	89 (23.9%)	99 (26.6%)	86 (23.1%)	98 (26.3%)	372 (100%)

Missing: 6 Chi-square significance: .004

As noted, if management controls and processes are important for a firm’s survival [49], then in terms of data security, a policy is required [43]. Policies can be informal or formal, but in order to gather definitive data on the issue, a focus was put on whether firms had a written security policy or not. Table 12 shows a cross-tabulation of frequency of response to the question, “Does your company have a written security policy for employee use of IT?” and sector. Percentages of the total sample are shown in parentheses. 40% of the valid responses answered ‘yes’ to this question. The only sector with a greater proportion responding ‘yes’ rather than ‘no’ of valid responses is ‘Internet Services’ (53% against 47% of sector responses respectively). This may highlight the fact that ‘Internet Services’ firms are generally more aware of the need for data security than other sectors. However, that said, it may be surprising given the nature of their business that this proportion is not even higher. Arguably, a surprising finding too given the general level of ‘yes’ responses overall is the figure for ‘Food Processing’ (45% of sector responses). This compares favourably with ‘media’ and ‘logistics’ (30% and 32% of ‘yes’ sector responses respectively). We can speculate that this may be a by-product of conformance requirements whereby food processing firms must be able to demonstrate traceability of food products.

Table 13: Written Security Policy by Size

	Size			
	Micro	Small	Medium	Total
Yes	52 (14.0%)	73 (19.6%)	24 (6.5%)	149 (40.1%)
No	148 (39.8%)	66 (17.7%)	9 (2.4%)	223 (59.9%)
Total	200 (53.8%)	139 (37.4%)	33 (8.9%)	372 (100%)

Missing: 6 Chi-square significance: .000

Table 13 shows a cross-tabulation between frequency of response to the question, “Does your company have a written security policy for employee use of IT?” and size of firm. Percentages of the sample are shown in parentheses. What is notable from the valid

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data is a size effect even if the number of ‘medium-sized firms’ is relatively low (33) in comparison to ‘small firms’ (139) and ‘micro firms’ (200). Thus the larger the size, the more likely the firm is to have a written security policy. Breaking down valid data by size shows that 26% of ‘micro firms’, 53% of ‘small firms’ and 74% of ‘medium firms’ have written security policies. This finding chimes with the DTI findings (as noted, their sample included large firms) which found that “larger companies remain more likely to have a security policy” (p. 7) with 60% of UK businesses having no formal security policy [42].

3.9 Employee Training for IT Security Awareness

Table 14: Employee Training for IT Security Awareness by Sector

	Sector				
	Media	Logistics	Internet Services	Food Processing	Total
Yes	41 (11.1%)	40 (10.8%)	66 (17.5%)	50 (13.5%)	196 (52.8%)
No	48 (12.9%)	60 (16.2%)	19 (5.1%)	48 (12.9%)	175 (47.2%)
Total	89 (24.0%)	100 (27.0%)	84 (22.6%)	98 (26.4%)	371 (100%)

Missing: 7 Chi-square significance: .000

Table 14 shows a cross-tabulation between frequency of response to the question “Do your employees get training to make them aware of IT security issues?” and sector. Percentages of the sample are shown in parentheses. If having a written security policy demonstrates management commitment to data security in theoretical terms, then devoting time and effort to awareness training of staff on IT security issues may be seen as putting theory into practice to some extent. Across the whole sample, nearly 53% of valid responses answered ‘yes’ to this question. Two sectors (‘Internet Services’ and ‘Food Processing’) have a greater proportion of their sample providing such training than not, while for the other two sectors (‘Media’ and ‘Logistics’) the converse is true. What is notable is the extent to which ‘Internet Services’ firms provide such training (79% of valid sector responses), while corresponding figures for ‘Food Processing’, ‘Media’ and ‘Logistics’ trail behind with figures of 51%, 46% and 41% respectively.

Table 15 shows a cross-tabulation between frequency of response to the question “Do your employees get training to make them aware of IT security issues?” and firm size. Percentages of the sample are shown in parentheses. Again a limitation to the findings here is that the number of ‘medium-sized firms’ in the valid sample is relatively low (33) in comparison to ‘small firms’ (138) and ‘micro firms’ (200).

Table 15: Employee Training for IT Security Awareness by Firm Size

	Size			
	Micro	Small	Medium	Total
Yes	92 (24.8%)	83 (22.4%)	21 (5.7%)	196 (52.8%)
No	108 (29.1%)	55 (14.8%)	12 (3.2%)	175 (47.2%)
Total	200 (53.9%)	138 (37.2%)	33 (8.9%)	371 (100%)

Missing: 7 Chi-square significance: .016

With that stated, the table shows that more ‘small firms’ and ‘medium-sized firms’ offer such training than not, with ‘micro firms’ showing the converse. There is a size effect here, and breakdown by valid response shows this more clearly: 64% of ‘medium-sized firms’ and 60% of ‘small firms’ offer this training while only 46% of ‘micro firms’ do so.

3.10 ‘Offsite Working’ and Training

Table 16: Training for Awareness of IT Security Issues v ‘Offsite Working’				
Training for awareness of IT security issues?		‘Offsite Working’?		
		Yes	No	Total
	Yes	117 (32.1%)	75 (20.6%)	192 (52.7%)
	No	68 (18.7%)	104 (28.6%)	172 (47.3%)
	Total	185 (50.8%)	179 (49.2%)	364 (100%)

Missing: 12 Chi-square test significance: .000

At this point, consideration is turned to levels of training on IT security awareness versus ‘offsite working’ (which, as noted above, is a reasonable analogue for ‘telework’). Table 16 shows a cross-tabulation of frequency of response to the questions “Do your employees get training to make them aware of IT security issues?” and “Do any of your company’s personnel work offsite with access to your information systems (or ‘telework’)?” Proportions for the sample of 364 valid responses are shown in parentheses. [On a methodological note, from this point findings for total numbers of responses may differ with those cited in sections above. So whereas the number of those having ‘offsite working’ noted above is 367 (with missing data for 11 firms), and the equivalent number for ‘training for awareness of IT security issues’ is 371 (with missing data for 7 firms), the confluence of data for these two responses produces a total of 364 in Table 16. If data is missing for either question, then that case will be ignored for analysis purposes. Variability of totals for the same question between different cross-tabulations is explained by the fact that missing data can be mutually exclusive (i.e. where data is missing for one question only) or mutually inclusive (i.e. where data is missing for both questions)].

Table 16 shows that 32% of the sample have both ‘offsite working’ and training on IT security awareness. To highlight a possible area for concern in terms of data security, attention should be drawn to the confluence of the ‘yes’ to ‘offsite working’ figure and the ‘no’ to training figure (18.7% of the total sample). Thus 37% of the 185 firms having ‘offsite working’ have no awareness training on IT security for employees.

Table 17 shows a cross-tabulation of frequency of response to the questions “Does your firm have a written security policy for employee IT use?” and “Do any of your company’s personnel work offsite with access to your information systems (or ‘telework’)?” Proportions of responses for the whole sample are shown in parentheses. 28% of the responses show firms with both ‘offsite working’ and a written security policy. To mirror the concern for data security shown in the analysis from Table 16, 46% of those firms having ‘offsite working’ do not have a written security policy.

3.11 'Offsite Working' and Security Policy

Table 17: Written Security Policy v 'Offsite Working'				
Written Security Policy?		'Offsite Working'?		
		Yes	No	Total
	Yes	101 (27.8%)	46 (12.4%)	146 (40.2%)
	No	85 (23.4%)	132 (36.4%)	217 (59.8%)
	Total	186 (51.2%)	177 (48.8%)	363 (100%)

Missing: 13

Chi-square test significance: .000

3.12 'Offsite Working', Security Policy and Firm Size

Table 18: Written IT Policy for Employee Use v 'Offsite Working' v Firm Size					
Firm Size		'Offsite Working'?			
		Yes	No	Total	
Micro	Written IT Policy for Employee Use?	Yes	28 (14.3%)	24 (12.2%)	52 (26.5%)
		No	54 (27.6%)	90 (45.9%)	144 (73.5%)
		Total	82 (41.8%)	114 (58.2%)	196 (100%)
Small	Written IT Policy for Employee Use?	Yes	53 (39.0%)	18 (13.2%)	71 (52.2%)
		No	25 (18.4%)	40 (29.4%)	65 (47.8%)
		Total	78 (57.4%)	58 (42.6%)	136 (100%)

Data for 'Micro firms'

Missing: 9 Chi-square significance: .041

Data for 'Small firms'

Missing: 4 Chi-square significance: .000

At this point, consideration of data security is made on the basis of three variables including firm size. Table 18 shows the cross-tabulation of frequency of response to the questions: "Does your firm have a written security policy for employee IT use?", "Do any of your company's personnel work offsite with access to your information systems (or 'telework')?", and firm size. Proportions of responses *by firm size* (i.e. according to 'Micro firms' and then according to 'Small firms') are noted in parentheses. As the data for 'medium-sized firms' was not statistically significant according to the chi-square test, this has been excluded. Of the 82 'Micro firms' that have 'offsite working' in this sample, only 28 (34% of 'Micro firms' with 'offsite working') have a written security policy for employee use, with 54 responses (66%) showing that 'remote working' is undertaken without such a policy. For the 'Small firm' sample, 53 responses show 'offsite working' (68%) with a written security policy, and 25 (32%) undertake 'offsite working' without such a policy. There is an apparent size effect here: the larger the firm the greater the likelihood that those having 'offsite working' will also have a written security policy.

3.13 'Offsite Working', Security Policy and Sector

Table 19: Written IT Policy for Employee Use v 'Offsite Working' v Sector					
Firm Size			'Offsite Working'?		
			Yes	No	Total
Logistics	Written IT Policy for Employee Use?	Yes	20 (20.4%)	12 (12.2%)	32 (32.7%)
		No	17 (17.3%)	49 (50.0%)	66 (67.3%)
		Total	37 (37.8%)	61 (62.2%)	98 (100%)
Food Processing		Yes	26 (27.7%)	16 (17.0%)	42 (44.7%)
		No	14 (14.9%)	38 (40.4%)	52 (55.3%)
		Total	40 (42.6%)	54 (57.4%)	94 (100%)

Data for 'Logistics'

Missing: 2 Chi-square significance: .000

Data for 'Food Processing'

Missing: 6 Chi-square significance: .001

Table 19 shows the cross-tabulation of frequency of response to the questions: "Does your firm have a written security policy for employee IT use?", "Do any of your company's personnel work offsite with access to your information systems (or 'telework')?", and sector. Proportions of responses *by sector* (i.e. according to 'Logistics' and then according to 'Food Processing') are noted in parentheses. The data for 'Media' and 'Internet Services' was not statistically significant according to the chi-square test, and therefore have been excluded. Of the 37 'Logistics firms' that have 'offsite working' in this sample, 20 (54% of 'Logistics' firms with 'offsite working') have a written security policy for employee use, with 17 responses (46%) showing that 'remote working' is undertaken without such a policy. Of the 40 'Food Processing' firms with 'offsite working', 26 responses show 'offsite working' (65%) with a written security policy, and 14 (35%) undertake 'offsite working' without such a policy.

It would be natural at this point in the chapter to make further consideration on the basis of firm size *or* sector cross-tabulations with training for IT security awareness and 'offsite working'. However much of the SPSS analysis returns lacked statistical significance according to the chi-square test, and thus will be ignored here.

Conclusion

This chapter attempts to help fill a gap in the academic literature on data security issues in relation to electronically-mediated working by SMEs. Based on a telephone survey of 378 firms, this analysis represents a 'first pass' of the 'WestFocus' quantitative data. The SME literature shows that data security is a subject mainly examined in combination with some other issue(s); there are few studies dedicated to security issues raised by telework. General findings on Internet-related technologies show that the basic infrastructure for secure distributed working and electronically-mediated trading is in place for the sample as a whole. Mirroring work on e-commerce adoption [6, 21], evidence was found for differences

in 'offsite working' on the basis of sector, and for data security practices on the basis of both sector and size. In terms of sector, 'Internet Services' demonstrated greatest attention to data security risks in terms of written security policies and provision of training for IT security awareness. Overall the other three sectors ('Food Processing', 'Media' and 'Logistics') came some way behind. Due to the nature of their business, it is perhaps unsurprising that 'Internet Services' would lead the race in these terms, but what was surprising was the fact that 'Food Processing' came ahead of the 'Media' and 'Logistics' sectors. In terms of size, generally the larger the firm, the greater the levels of written security policies and training in evidence, which chimes with work on e-commerce adoption [15, 23]. However, no matter what the size or sector, significant numbers of firms in the survey lack written management controls for data, and as a result questions remain over their security posture. Distributed working cannot flourish amongst such SMEs without greater concern for data security.

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Acknowledgement

The author would like to acknowledge the financial support provided by WestFocus* under the Higher Education Innovation Fund (HEIF 2) and the contributions of the other project team members: David Barnes, Romano Dyerson, G. Harindranath and Wendy Gerrish (all Royal Holloway University of London), Keith Dickson and Lisa Harris (Brunel University), Paul Wallin (Kingston University) and Alan Rae (Ai Consultants). (*WestFocus is a partnership between universities, SMEs and community groups in South and West London and the Thames Valley, UK.)

e-Networks for Emergency Management: The Case of Agro-Terrorism and Agricultural Epidemics

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Abstract: Advances in e-networks and complementary technologies (e.g., bio-sensors, haptics, RFID, tele-operations, virtual reality) are offering the prospect of revolutionary advances in how to meet requirements for "surge capacity" in emergency management. This chapter examines the case of agricultural epidemics (particularly among livestock), as may be caused by natural outbreaks or agro-terrorism, and some of the challenges in their management. E-networks and related technology can be expected to facilitate the virtual presence, but with real operational impact, of experts and specialists in traffic control and biosecurity for quarantined regions, earlier diagnosis of infection by exotic diseases, and global bio-surveillance for tracking the movement of pathogens and vectors.

Telework and more broadly e-networks are opening up new possibilities for more effective management of large-scale emergencies. Containing the scale and impact of natural disasters, industrial accidents or terrorist attacks, and keeping them from becoming catastrophes can be a formidable challenge. Success lies largely in having the capacity for the rapid mobilization of dispersed resources (human and material) and efficient coordination of all parties involved. Failure can result in a range of costly negative effects from crippling financial burdens to extensive human suffering and even political instability.

Over recent years, we have seen a variety of emergencies around the world and a gamut of responses with which they have been met - among them the ice-storm of 1998 in central Canada, the attack on the World Trade Center in 2001, the outbreak of SARS in Toronto during 2003, the Asian tsunami of 2004, South Asia's earthquake in 2005, the transit bombings in Madrid (2004) and London (2005), and Hurricane Katrina in 2005. History and science tell us that we can expect to face greater and lesser emergencies driven, among other things, by ethno-cultural frictions, global political and economic competition, environmental degradation, and natural forces in the bowels of the Earth and above in the heavens.

An area of growing concern to many in emergency management and national security is biological threats. A number of factors are seen as driving the prospects of direct and indirect risks to public health and the economy through the spread of infectious diseases.

One is globalization is causing greater numbers of people, goods, animals and plants to move around the planet at ever increasing speed and often from obscure and remote corners of the world. This unprecedented movement brings with it the risk of disease as familiar and unfamiliar pathogens piggyback as clandestine travelers.

Two is the increasing number of pathogenic strains that are resistant to anti-biotics.

Third, climatic change and it's most common manifestation, global warming, is facilitating the northward migration of diseases.

Fourth is the burgeoning field of biotechnology including genomics, proteomics, computational biology and so on. The USA's National Research Council, along with others, is apprehensive about how advances in genetics and biotechnology are giving rise to opportunities for the creation of biological weapons. Many experts have become concerned that biological warfare - once an area of experimentation almost exclusively occupied by great powers - is now an option for terrorists.

Fifth, whether or not terrorists have access to the requisite expertise to exploit developments on the frontiers of science, within the ranks of some terrorist groups there are already people with advanced degrees in science and engineering - giving them sufficient competence to exploit the existing knowledge on many disease-causing agents.

While the primary focus on biological threats (natural and human-made) is on those directly endangering human populations, over the last decade, concern has been mounting over the risk of agricultural terrorism (agro-terrorism). Among the causes of unease for experts over the prospects for agro-terrorism, we can take all of the factors cited above with respect the spread of infectious diseases and then add the recurrent outbreaks in the agricultural sector among livestock and crops. These have included avian influenza (which has broken out several times in recent years in North America and Europe as well as Asia), bovine spongiform encephalopathy (BSE) among cattle in Canada, USA and UK; and foot-and-mouth disease (FMD) Taiwan's swine in 1997 and then in 2001 (and a couple of times in the Twentieth Century) among several species of the UK's livestock. All of these outbreaks have resulted in costs in the billions of dollars, heavily disrupted local societies, and had political fall-out domestically and internationally. Similarly, food-crops have been ravaged, typically by varieties of fungi, with cases that have run into the hundreds of millions of dollars.

The costliness of agricultural epidemics, the difficulties of managing the emergencies they create, and fears over the potential threats to public health and social order, as well as food security, are fueling a search for new technologies to help in the prevention and mitigation of, and response to, outbreaks of agricultural diseases.

This chapter is intended as a bridging effort between the emergency-management community and the telework/e-network community and is meant to provide topics for a common agenda. It will posit some of the challenges that beset those charged with handling emergencies and which would appear to be amenable to amelioration by the harnessing of e-networks and telework. In some cases, the solutions may not be

immediately at hand but will be in the future as the requisite advances are made variously in infrastructure and in areas of cybernetic engineering complementary to e-networking.

The problems in the management of agriculturally driven emergencies are chosen from two streams of literature - the core of which involves a handful touchstone documents. The first stream is a set of three major reports produced in Britain that collectively constitute a post-mortem on the disastrous natural outbreak of foot-and-mouth disease in 2001 and that prescribe measures for more effective management in the future. The second stream, marginally more voluminous, is a body of writings produced primarily in the USA over the last decade and deals with the risk of agricultural biological terrorism and sabotage. Integral to the report is the history of preparations made for, and tales of limited experimentation in, biological warfare by various nations - primarily the super and great powers of the last century. Out of this second stream, arguably the most valuable work was that of the USA's National Research Council - published in 2002 and 2003.

The identification and discussion, in this chapter, of three of the most formidable challenges in agro-emergency management is a story to be told in reverse. That is, the chapter will first describe the basic cycle of emergency management (preparation and prevent mitigative measures, then detection and alarm, and subsequently the main response, followed by recovery). Following this discussion, the chapter will then introduce each of the three problems chosen for their perceived amenability to more effective handling through e-networks.

In order of the discussion, the first problem is the management of movement related to wide areas of quarantine. Epidemiologically dictated measures to stem contagion typically involve moderate to severe restrictions on the movement of vehicles, goods and people, as well as of agricultural items (livestock and crops) in an effort to stop the unintended transport of pathogens out of infected areas and into uninfected ones. This control is essential to containing an outbreak, but it is also formidable as a problem in optimizing the control of disease with accommodation of a necessary minimum of access and egress essential to preventing the complete economic and social collapse of affected communities. The potential contribution of particular emerging technologies will be cited along with how these can only be harnessed through e-networks.

Certainly an obvious additional contribution to the mitigation of the negative effects of the type of emergency measure - restriction of personal and vehicular traffic - is that which can be made by arrangements for telework. We can see that pre-existing arrangements would constitute a type of resilience. But, can we imagine a system for temporary provisions for quarantined communities to ease them through a period of crisis?

The second problem is that of timely and reliable diagnosis of infections. On one hand the early sounding of alarm of a suspected infection can mean quicker imposition of higher levels of bio-security and offer greater assurance of geographic containment of an outbreak. However, should this prove to be a false alarm, there can still be severe economic costs as word of certain listed diseases results in the immediate imposition of trade restrictions - restrictions which may be imposed far more quickly than they may be lifted. Once an outbreak has started, accurate and timely diagnosis across a much wider set of adjoining areas - potentially of thousands of square kilometers overnight - is imperative.

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Both the problems of traffic-control and of diagnosis require a “surge capacity” to bring experts into the arena of the emergency. The actual movement of experts, from across the country and into the geographic areas where they are needed, may simply not be possible on a sufficiently timely and prolonged basis. Arrangements for telework, however, including the necessary complementary technologies to support the needs of various specialists, could increase ‘virtually’ the ranks of the experts - be they veterinary, forensic, engineering, or other.

The third problem to be discussed is for a system of systems that would provide a global view on the hemispheric, continental and trans-border movement of agricultural diseases and pathogens. The seeds of this type of global monitoring exist but are still very embryonic. An effective system will only be possible with e-networks of sensors woven in with e-networks of a spectrum of experts. Envisioning what such a global system would look like and how it would function will help us to build it.

The International Telework Association (ITA), in partnership with the University of New Brunswick's Faculty of Business Administration, hosted the 11th International Workshop on Telework. The 2006 Workshop was the first held in North America, taking place in Fredericton, New Brunswick — Canada's first city to support a free urban wireless network.

The theme of the 2006 Workshop, *e-Networks in an Increasingly Volatile World*, specifically examined work strategies that involve e-networks and contribute to greater preparedness. Academic research papers and practitioner cases from around the world were presented in response to the specific call of the 2006 Workshop, as well as to the standing e-work streams welcome at every ITA hosted event. This Proceedings is a selection of papers and cases presented at the Canada 2006 Workshop.

Previous International Workshops on Telework have assembled participants in:

Preston, England 2005
Living, Learning and Working in Virtual Environments

Crete, Greece 2004
Telework and Future Forms of Organizing

Sao Paulo, Brazil 2003
E-Work and Socio-Economic Development

Badajoz, Spain 2002
Designing a New Work Space: Sustainability and Ethical Dimensions

Amsterdam, Netherlands 2001
Working in the New Economy

Stockholm, Sweden 2000
2000 and Beyond: Telework and the Future of Work

Tokyo, Japan 1999
Telework Strategies for the New Workforce

Turku, Finland 1998
Telework Environments

Amsterdam, Netherlands 1997
Building Actions on Ideas

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New International Perspectives on Telework: From Telecommuting to the Virtual Organisation

ISBN 1-55131-107-0